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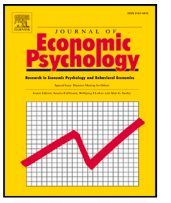

# Motivate the crowd or crowd them out? Experimental evidence on the impact of local government spending on the voluntary provision of a green public good☆,☆☆

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ABSTRACT

Cities are increasingly being held accountable for their climate action. By demonstrating their pro-environmentality through their own climate-related activities, they aspire to encourage individual climate protection efforts. However, economic theory posits that this strategy may not be as promising as it appears. Since cities fund these initiatives using taxpayers' money, their contributions may be perceived as substitutes, potentially crowding out private contributions to the same public good. Inspired by research on the crowding-in effects of social norms, leadership, and the expressive influence of laws, we challenge this argument. We conducted a framed field experiment to analyze whether providing information on the previous contributions made by the city itself has an impact on individual private contributions to the same public good. Results show no statistically significant evidence that city contributions reduce resident contributions. Instead, referencing fellow citizens increases contributors, attracting especially those less pro-environmentally oriented.

## 1. Introduction

Cities are uniquely positioned not only to experience the impacts of climate change and to play a pivotal role in driving climate action (IPCC, 2022). Home to 55 percent of the global population, cities consume two-thirds of the world's energy and account for 70 percent of global greenhouse gas emissions (UN-Habitat, 2021). At the same time, by controlling one-third of public expenditures, two-thirds of public investment, and wielding regulatory authority, cities are well-positioned to take climate action — and they do so. In order to enhance climate ambition, cities are regarded as pivotal intermediaries, facilitating communication between their citizens and other governmental entities. They play a crucial role in promoting voluntary actions by fostering behavioral and lifestyle modifications (IPCC, 2022). This perspective is consistent with the self-perception of cities. A study of German municipalities' climate efforts found that local authorities primarily viewed their role as setting an example for citizens to adopt pro-environmental behaviors (Alsheimer et al., 2021).

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This position is challenged from a public economics point of view. Theoretical research in this field explores the private provision of public goods and its interaction with governmental policies. According to this research, voluntary private contributions to a public good are crowded-out dollar for dollar by government contributions to the same public good (Bergstrom et al., 1986; Bernheim, 1986; Roberts, 1984; Warr, 1982). This is especially true if individual contributors prioritize the overall provision of the public goods and perceive government spending, predominantly financed through taxation, as a substitute for their private contributions (Andreoni & Payne, 2003). Consequently, publicly proclaiming city-level climate mitigation initiatives and expenditures may potentially diminish the perceived value of individual contributions.

Empirical evidence on the crowding-out effects of government spending on individual contributions is mixed. Laboratory experiments generally find substantial crowding-out effects (e.g. Andreoni, 1993; Eckel et al., 2005). However, observational studies report that crowding-out is either incomplete and small (Andreoni & Payne, 2003; Khanna et al., 1995; Kingma, 1989; Payne, 1998), or positive (Payne, 2001). Steinberg (1991) and de Wit and Bekkers (2016) provide comprehensive reviews and meta-studies. Explanations for incomplete crowding-out can be attributed to people deriving some "private value" from contributing, driven by other-regarding preferences such as warm glow (Andreoni, 1990, 1993), moral satisfaction (Kahneman & Knetsch, 1992), and self-image (Brekke et al., 2003). Furthermore, contributions may be indicative of values that emerge from social interactions, including social norm following, social approval (Holländer, 1990), considerations of fairness and reciprocity (Nyborg & Rege, 2003), and interdependence between individuals and their respective reference groups (Andreoni & Scholz, 1998). If this holds true for City Governments, the revelation of their expenditure on climate change mitigation initiatives may result in heightened civic engagement rather than the displacement of private contributions.

To test these competing hypotheses, we conducted a framed field experiment with nearly 500 citizens from a major German city, to investigate the substitutability between individual contributions, local government spending, and peer contributions to a local afforestation project. Prior to making their own real contribution to the green public good, participants are randomly divided into three different groups. These groups receive information about existing contributions to the same afforestation project from either the City Government (the *City* treatment), or from other study participants residing in the city (the *Citizen* treatment). A third group functions as a control, receiving no prior information regarding the contributions of others. We complement our experimental data with additional survey evidence to better understand the impact of heterogeneities in pro-environmental traits and identification on treatment effects.

We present two primary findings. Firstly, we do not find statistical evidence for changes in individual climate protection efforts when City Government spending is revealed. Secondly, in contrast, a reference to efforts of fellow citizens notably enhances the share of donors to the local green public good. With respect to the initial endowment of 15 EUR, the total average contributions increase by 9.5 percentage points in the *Citizen* treatment compared to the *City* treatment. Consequently, despite the pivotal role of city contributions to climate mitigation and adaptation in the global effort to combat climate change, we do not find evidence that information and awareness of these initiatives alone can effectively catalyze voluntary behavioral shifts. A more effective strategy to foster citizen climate action would likely involve communicating activities within local neighborhood networks.

Our experimental design speaks to two additional strands of literature. First, it contributes to the social norm literature by leveraging the design of our treatments, which provide participants with information about the behavior of others, commonly referred to as descriptive norm information. Recent research has extensively examined the use of descriptive and injunctive norm information (Brennan et al., 2016; Cialdini & Goldstein, 2004), and it is well-established that providing information about prevalent behavior within a group can indeed trigger behavioral change. Dannenberg et al. (2024) provide a comprehensive overview of laboratory and field experimental studies on social norm interventions aimed at promoting environmentally friendly behaviors, and also identify relevant gaps in the literature. Specifically, they highlight a lack of systematic investigation into the role of social networks and reference groups, in particular, also with respect to the interactions between political elites and the public.

Reference groups play a critical role in norm conformity and the effectiveness of social norm interventions, as "it potentially matters which members of the community hold the attitudes and which do not" (Brennan et al., 2016). Since norm-based behavioral interventions have gained increased popularity in recent years, future policy designs should carefully consider the appropriate level of reference-based information. Our study contributes to this literature by deploying treatments that vary only the reference group, enabling a direct comparison of revealed contribution behavior. One group receives descriptive norm information from a potentially closer reference group (fellow citizens), while the other receives descriptive norm information from a potentially more distant reference group (the local City Government). Although the government may appear more distant, it is democratically elected and possesses greater resources to address public goods. Consequently, our setup enables us to view contributions from different sources as perfect substitutes and to analyze the interplay between government and private provision to the same good as well as peer group and private provision. However, while the marginal per capita return from individual contributions remains constant across treatments, given the nature of our reference groups, total public goods provision levels will differ before participants indicate their individual choices. Individuals, being predominately interested in achieving a certain level of the green public good, will consequently pay higher attention to existing provision levels rather than the closeness of the reference group.

Second, to the best of our knowledge, three studies provide empirical evidence on the impact of governmental climate actions on private contributions. Using a panel data set on volunteerism in U.S. National Parks, Kotchen and Wagner (2023) report that each additional dollar of federal funding to the parks crowds in, on average, 27-cents worth of volunteerism in protecting and maintaining national parks. A study by Richter and Stijn (2023) investigates the inverse of our research question, examining how a decrease in governmental spending influences private contributions. This discourages citizens from voluntarily completing an online survey that generates donations to The Hague Forest, emphasizing the importance of the government's role as a reliable partner in its reciprocal relationship with citizens. Huber et al. (2018) conducted an experimental study among Swiss car owners to

investigate how institutional signals from the Swiss government and group signals from Swiss citizens impact individual voluntary carbon offsetting. The institutional signal treatment provides information on a Swiss legislation mandating fossil fuel importers to offset emissions, while the group signal treatment involves information about Swiss citizens voluntarily compensating. The authors do not find that either treatment can significantly increase the rate of offsetting compared to a control group.

We contribute to this growing literature on multi-level climate governance in several dimensions. We offer an experimental design which builds upon a single, single-dimension climate mitigation activity which is both measurable and substitutable. Using a broad population sample, our framed field experiment allows us to empirically investigate the interplay between city-level climate efforts and voluntary contributions in a single domain, which is key for measuring underlying crowding-out effects. In contrast to prior work, our experimental setting does not only provide unique insights into the impact of public expenditures on the support of local afforestation activities; at the same time, it also offers comparable effect sizes of an alternative approach that rather targets reference to activities within local neighborhood networks.

The remainder of the paper is structured as follows. Section 2 provides a detailed overview of the experimental design, outlining the procedures and treatments, as well as the additional survey measures employed to capture individual-level heterogeneities. Section 3 develops hypotheses regarding the expected treatment effects, drawing on insights from the literature. Section 4 presents the primary findings on our treatments, and conducts an in-depth analysis of heterogeneities in treatment responses. Finally, Section 5 discusses the broader implications of our findings and concludes with recommendations for policy and future research directions.

## 2. Setting and data

### 2.1. Experimental design and sampling

This study is based on a framed field experiment conducted in autumn 2020. We utilized an online survey, created with LimeSurvey, to implement the experimental intervention. Subjects were recruited from an existing citizen panel and through random mail invitations in the City of Mannheim. Subjects were invited to participate in an online survey on the EU General Data Protection Regulation (GDPR), which took approximately 18 min to complete. Participants received a fixed reimbursement of EUR 15 for their full participation.

The experimental intervention began after subjects finalized the GDPR questions. Subjects were randomly assigned to one of three treatment groups, each offering the opportunity to allocate their fixed reimbursement toward supporting additional tree planting at an afforestation project located in Mannheim. Before deciding on their contribution to the afforestation project, all subjects were presented with identical information about the importance of climate protection, the Paris Climate Agreement goals, the role of trees as carbon sinks, and details about the afforestation project. The afforestation project was part of the 2023 German National Garden Show (BuGa), a renowned biennial federal horticultural exhibition. In 2023, Mannheim served as the host city, transforming previously sealed areas into green spaces with approximately 1000 newly planted trees, thereby creating a new carbon sink. Subjects were informed that their contributions would be used to fund the planting of additional trees in this area. Only after receiving this information were subjects asked to indicate their willingness to contribute to the project. Specifically, subjects were asked to indicate their willingness to pay for the additional removal of 100 kg $CO_2$ from the atmosphere. For this we employed a slider starting at EUR 0, with increments of 10 cents. The maximum contribution allowed was EUR 15, which corresponded to participants' full reimbursement. Our three experimental treatments were displayed on this contribution decision screen.

In the control group, the contribution decision was presented in a neutral manner, informing participants about their free choice of contribution amount, followed by the slider to indicate their desired contribution. In the *City* treatment, we highlighted the spending of the Mannheim City Government on the afforestation project by adding the following paragraph before the adjustable slider: "The following information may be helpful for your decision: In preparation for the German National Garden Show 2023, native trees are being planted on behalf of the City of Mannheim. According to current information, the city is investing approximately EUR 3 per resident of the inner Mannheim city area for this purpose". To further illustrate this reference, we included an image of a slider set at EUR 3 above the adjustable slider for both reference treatments (see Supplementary material Figure A.2). In the *Citizen* treatment, we highlighted the contributions of previous study participants from Mannheim to the afforestation project by adding the following paragraph before the adjustable slider: "The following information may be helpful for your decision: In recent weeks, 145 people have already participated in this survey. The average donation from survey participants in Mannheim was approximately EUR 3". As in the *City* treatment, we included an image of a slider set at EUR 3 above the adjustable slider.

Thus, compared to the control group, the *City* and *Citizen* treatments provided additional information about the contribution behaviors of different reference groups to the same afforestation project. To ensure comparability and facilitate interpretability of results regarding the reference groups, we varied only the reference group (Mannheim City Government vs. Mannheim citizens) while keeping the reference value constant at EUR 3. This was achieved by conducting the treatments in two waves.

First, we implemented the control group condition, which showed that subjects in Mannheim had a mean willingness to pay of EUR 3. This value was subsequently used as the reference point in the *Citizen* treatment, conducted two weeks after the control condition and concurrently with the *City* treatment. For the *City* treatment, we obtained an estimate of the planned tree-planting spending from the project organizers. To align this estimate with the EUR 3 reference value, we reported the spending as an equivalent per resident of Mannheim's inner city area. Additional information on our sampling procedures, power analysis, and the experimental instructions can be found in Supplementary material.

### 2.2. Survey data

In addition to our experimental outcomes, we elicited a rich array of supplementary information, enabling a deeper exploration of the behavioral and motivational mechanisms underlying our main outcome variable across treatments. Specifically, to better understand potential responses to our treatments, we utilized survey measures focusing on: (i) pro-environmental attitudes, and (ii) identification with the City of Mannheim.

Previous research has established a positive correlation between pro-environmental behaviors (Derdowski et al., 2020; Stern, 2000), prior engagement in environmental actions (Huber et al., 2020), and the New Ecological Paradigm (NEP) indicator, which assesses beliefs and perceptions concerning how humans handle and relate to the environment (Dunlap et al., 2000). To identify whether predispositions toward pro-environmentalism influence behavior, we elicited participants' past climate engagement, their motivation for climate action, when observing the climate activities of others, as well as their NEP score and their (green) voting behavior.

In addition, compliance with group norms strongly depends on the strength of shared group identity (Terry & Hogg, 2000; Turner et al., 1979). Prior research has demonstrated that offering information about reference group behavior is more effective for closer reference groups than for more distant groups (Goldstein et al., 2008; Lapinski & Rimal, 2005; Neighbors et al., 2008). Consequently, the effectiveness of the reference frame in our treatments may depend on participants' identification with the city. To address this, we used the 'Other in the Self' scale (Aron et al., 1992) to measure how close our respondents feel to their city, as well as the district they live in. We also asked participants on a five-point Likert scale how happy they feel living in their district, and whether they are active in any local organization.

Moreover, the effect of the *City* treatment could be shaped by participants' prior beliefs about existing climate efforts of the city. If the information about City Government spending aligns with, exceeds, or undercuts participants' expectations of general government spending for climate matters, our treatment may have limited impact. To address this, we measured participants' familiarity with their city's climate policies on a 5-point Likert scale and their perception of whether the city's climate actions are sufficient to address climate change.

## 3. Literature and expected treatment effects

We anticipate that individuals' contribution behavior will vary systematically depending on the reference group to which they are exposed, whether that group be the City of Mannheim or fellow citizens. Specifically, we hypothesize that these behaviors will reflect the interplay of two opposing forces: a potential crowding-out effect, whereby individuals reduce their own contributions in response to the perceived substitutability of others' spending, and a crowding-in effect, whereby individuals are motivated to align their actions with the norms established by the provided reference group. In this section, we will delve into a more thorough examination of the mechanisms underpinning the crowding-in and crowding-out effects in the *City* and *Citizen* treatments. It is important to note that our primary hypotheses and empirical analyses compare each treatment to the control condition rather than to one another. This approach enables us to isolate the net effect of the respective reference group on individual contributions. In essence, the experimental design employed captures solely the collective impact of these countervailing forces – what we refer to as the net crowding effect.

**Crowding-out due to the substitutability of spending:** The standard model of the private provision of public goods (Bergstrom et al., 1986; Cornes & Sandler, 1984) predicts that individuals care only about aggregate contributions to public goods. The neutrality property (Roberts, 1984; Warr, 1983) posits that rational agents are indifferent to the funding of a public causes through private or public means. Instead, the rational agent focuses solely on the overall funding levels (Andreoni, 1989, 1990). According to this premise, individuals perceive their own donations and those of others as perfect substitutes.

**Crowding-in due to norm following:** A second mechanism influencing contribution behavior emerges from social interactions within reference groups (Andreoni & Scholz, 1998). A reference group is a group with which individuals identify, use for social comparison, and whose values they adopt as guiding principles. Such groups establish norms that make individuals accountable to one another and provide social meaning to behavior (Brennan et al., 2016). Individuals tend to seek approval (Christensen et al., 2004) and conform to group norms (Cialdini & Goldstein, 2004; Lewin & Gold, 1999), making reference groups powerful drivers of social comparison and imitation (Welsch & Kühling, 2009). Social norms – shared expectations about appropriate behavior – play a pivotal role in shaping actions (Bicchieri, 2006; Brennan et al., 2016; Dannenberg et al., 2024) and form an important part of social identity (Hogg & Reid, 2006; Tajfel & Turner, 2004). Evidence shows that providing information about others' behavior can exert a substantial influence on individual decision-making processes (Bicchieri, 2023; Dannenberg, 2015).

**Expected treatment effects in the *City* treatment:** In the *City* treatment, where participants observe government spending, the substitutability of spending mechanisms is likely most relevant. Government spending is predominantly financed through taxes, which leads individuals to perceive public and private contributions as substitutes (Andreoni & Payne, 2003). From a theoretical standpoint, this would imply a crowding-out effect in the *City* treatment, relative to the control group, as individuals reduce their own donations in response to public funding of the same good. However, empirical evidence suggests that such crowding-out is often incomplete. Observational studies find only partial displacement of private giving (Brooks, 2000; Eckel et al., 2005; Khanna et al., 1995; Khanna & Sandler, 2000; Kingma, 1989), with Steinberg (1991) reporting that each additional dollar of government spending reduces private donations by just USD 0.05–0.35. In contrast, the meta-analysis by de Wit and Bekkers (2016) documented a slight crowding-in effect, with government support increasing private donations by approximately USD 0.06 per dollar. Concurrently, information regarding government spending may trigger a crowding-in response through normative signaling. According to the

theory of the expressive function of law (Cooter, 1998, 2000), public actions communicate collective intentions and clarify what behaviors are socially desirable. When governments actively address an issue, they can signal that the problem is legitimate and that contributing to its solution aligns with prevailing social norms (Galbiati et al., 2021; Tyler & Jackson, 2014). In this sense, city spending can function as a credible leadership signal, encouraging citizens to follow by example. Experimental and field studies consistently has demonstrated that leadership and "seed" contributions have a positive impact on both the quantity of donors and the total amount of donations (Bracha et al., 2011; Eckel & Grossman, 2003; Huck & Rasul, 2011; List & Lucking-Reiley, 2002; Saboury et al., 2022). Moreover, studies have shown that elected leaders, in particular, enhance social identification and promote norm compliance (Drouvelis & Nosenzo, 2013; Güth et al., 2007; Jack & Recalde, 2015). Taken together, these mechanisms indicate the presence of competing forces: While substitutability has the potential to reduce private giving, normative signaling and leadership cues have the capacity enhance it. Consequently, the overall effect of city spending on private contributions remains ambiguous.

> **H1:** Observing City Government spending on the public good may either crowd out contributions through perceived substitutability or crowd in contributions through normative signaling and leadership cues. The net effect on individual contributions is therefore theoretically ambiguous.

**Expected treatment effects in the *Citizen* treatment:** In the *Citizen* treatment, where participants observe the contribution behavior of fellow citizens, we expect crowding-in to dominate, with little or no crowding-out compared to the control group. According to social norm and reference group theories, individuals modify their behavior in accordance with the actions and expectations of their reference group (Bicchieri, 2006; Cialdini & Goldstein, 2004; Dannenberg et al., 2024). These effects are particularly strong when the reference group is socially proximate. That is to say, when individuals share a sense of identity, locality, or community with those being observed (Bicchieri et al., 2022; Dimant, 2019; Goldstein et al., 2008; Neighbors et al., 2008; Shang & Croson, 2009). A large body of experimental and field evidence supports this mechanism. The provision of information regarding the contributions of others has been shown to increase individuals' willingness to contribute to the same public good (Bryan & Test, 1967; Croson & Shang, 2008; Frey & Meier, 2004; Shang & Croson, 2006, 2009). Analogous, peer-information effects have been documented across a range of behavioral domains, including energy conservation, recycling, and voting (Allcott, 2011; Gerber & Rogers, 2009; Schultz, 1999; Schultz et al., 2007). Recent studies in the field of climate research have also highlighted that peer beliefs can influence mitigation behaviors. In a multi-country survey of 23 European countries, Welsch (2022) shows that individuals' willingness to engage in climate action is contingent on the perceived prevalence of others' efforts, following a U-shaped trend. At low perceived prevalence, additional information about peer engagement can diminish individuals' willingness to act. However, once a tipping point is reached, perceived peer engagement increases individuals' own contributions. These findings suggest that observing others' prosocial behavior serves as a powerful descriptive norm cue, motivating individuals to adhere to the perceived standards of their community. Applying this logic to the experimental design, the *Citizen* treatment provides participants with information about contributions from other residents of Mannheim – a socially proximate and identifiable in-group. This local framing reinforces social identification and norm alignment, thereby enhancing individuals' motivation to contribute to the same local public good. In this context, the donations made by others are not likely to be perceived as substitutes for one's own contributions. Rather, these donations are viewed as social signals that convey descriptive norms and indicate appropriate behaviors.

> **H2:** Observing the contribution behavior of fellow citizens increases individual contributions to the local public good compared to the control group, reflecting a net crowding-in effect driven by social norm alignment within a close reference group.

## 4. Results

### *4.1. Sample description and summary statistics*

We invited 1370 members of our citizen panel and received a total of 491 responses, resulting in a response rate of approximately 35.8%. The gender distribution was 46 percent female, with an average age of 38 years and a monthly net income ranging from EUR 1500 to 2000. The majority of participants held a university degree and were employed. Regarding voting preferences, 48 percent indicated that they would vote for the Green Party (Bündnis 90/Die Grünen) if elections were held, followed by 16 percent for the center-right political party (CDU/CSU), and 12 percent for the center-left political party (SPD).

Supplementary material Table B.1 provides descriptions of all relevant variables used in the analysis, while Supplementary material Table B.2 examines covariate balance across treatments. With respect to basic socio-economic characteristics, the balance table indicates that participants in the *Citizen* treatment are significantly older than those in the control group. We account for socio-economic factors in our regression analyses to address this difference. Supplementary material Table B.3 further compares our sample to both the general German population and the population of Mannheim. Relative to these reference groups, our sample is slightly younger, more highly educated, more likely to support the Green Party, and less inclined to vote for a far-right party. Subjects were nearly evenly distributed across conditions: 168 participated in the *Control*, 160 in the *Citizen*, and 163 in the *City* condition.

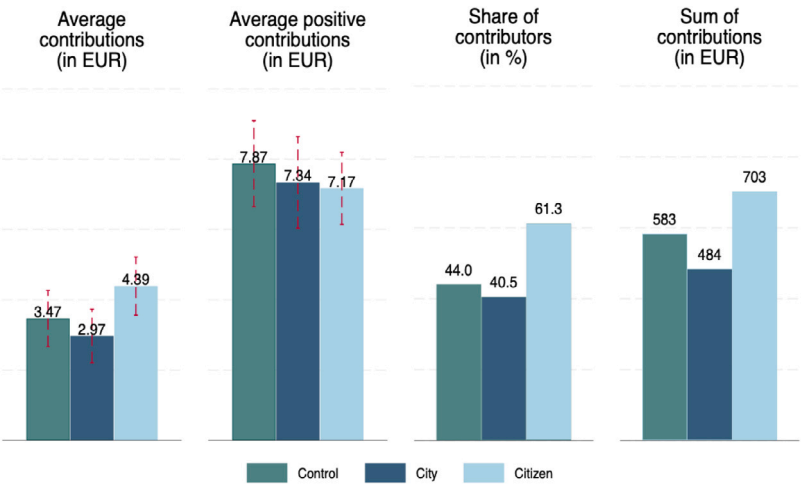


**Fig. 1.** Average contributions and share of contributors across treatments.
Note: The figure shows the mean contributions to the afforestation project with confidence intervals across the three different treatment groups. Average contributions include all contributions in the range of EUR 0 to EUR 15. Average positive contributions include only participants who contributed more than EUR 0. 168 subjects participated in the *Control*, 163 in the *City*, and 160 in the *Citizen* condition.

### *4.2. Contribution behavior*

Across all treatments, total contributions amounted to EUR 1770. This sum was transferred to the afforestation project, facilitating the planting of two Caucasian walnut trees, each already measuring five to six meters in height at the time of planting, in May 2021. Unlike many other tree-planting initiatives, we chose not to plant saplings. According to the project organizers, planting more mature trees is a more effective strategy, as these trees demonstrate higher resilience and survival rates, albeit at a higher cost.

**Overall contribution levels:** The mean contributions were EUR 3.5 in the control group, EUR 3.0 in the *City*, and EUR 4.4 in the *Citizen* treatment (see Fig. 1). Median contributions were found to be EUR 0 in both *Control* and *City*; however, they increased to EUR 3.0 in *Citizen*. We do not find evidence that either the *City* or the *Citizen* treatment had a statistically significant positive effect on contribution levels compared to the control group at conventional significance levels (see Table 1, column (1)). However, average contributions are significantly higher in the *Citizen* treatment compared to the *City* treatment (4.39 EUR vs. 2.97 EUR, p-value: 0.014). Given the near-identical number of observations across treatments, a direct comparison of the total contributions can be made. In the control group, the total contribution amounted to EUR 583. The *City* treatment received the lowest sum, amounting to EUR 484, while the *Citizen* treatment received the highest total contributions, at EUR 703. This variation across treatments was primarily driven by extensive margin effects, specifically changes in the share of contributors.

**Extensive margin effect:** In the control group, approximately 44 percent of subjects demonstrated a willingness to contribute. The proportion decreased to 40 percent the contributions of the Mannheim City Government in the treatment were highlighted. Conversely, when emphasizing the contributions of previous survey participants from Mannheim in the *Citizen* treatment, the proportion of contributors increased to 61 percent. This increase is statistically significant (see Table 1, column (2)).

**Intensive margin effects:** The mean positive contributions, defined as contributions that are strictly greater than EUR 0, were EUR 7.9 in the control group, EUR 7.3 in the *City*, and EUR 7.2 in the *Citizen* treatment (see Fig. 1). The median positive contributions remained consistent at EUR 5 across all groups. In contrast to the control group, no statistically significant influence was observed on mean positive contribution levels at conventional levels for the *City* and *Citizen* treatments (see Table 1, column (3)). Yet, average contributions are significantly higher in *Citizen* compared to *City* ($p$-value = 0.047). In the regression analyses, we included conventional socio-economic control variables, such as participants' age, gender, income, and education. Additionally, given that our study took place during the COVID-19 pandemic, we controlled for participants' financial status due to the pandemic, specifically, whether they encountered financial hardship as a result of the crisis. There is a statistically significant association between age and being female for the likelihood of making a positive contribution, as well as the average contribution levels. Whereas, being financially worse off due to the COVID-19 pandemic is associated with lower contribution levels and a lower likelihood of becoming a contributor at all. We held this set of control variables constant for the following regression analyses.

**Robustness check:** An inherent feature of our treatments is the introduction of two similar reference values. The introduction of the EUR 3 reference values may give rise to concerns regarding the possibility of anchoring bias influencing subjects' subsequent donation decision (Tversky & Kahneman, 1974). This could lead to an overestimation or underestimation of the true effect being measured (Ariely et al., 2003; Cason & Mui, 1998). This concern can be mitigated. Firstly, due to the randomization process, any potential anchoring bias present in the data should be consistent across both treatment groups. Secondly, an examination of the distribution of contributions across all treatment groups (see Supplementary material Figure A.3) reveals an increase in EUR 3 donations in both treatment groups compared to the control group. While only 1.8 percent of participants in the control

**Table 1**
Estimation results — Main treatment effects.

| | (1) | (2) | (3) |
|---|---|---|---|
| | Av. contributions (in EUR) | Share (in %) | Pos. contributions (in EUR) |
| $\text{Treatment}_{\text{Base = Control}}$ | | | |
| *City* | −0.46 (0.55) | −0.03 (0.05) | −0.57 (0.86) |
| p-value | 0.396 | 0.553 | 0.492 |
| *wyoung* FWER p-value | 0.686 | 0.762 | 0.762 |
| *Citizen* | 0.64 (0.54) | 0.16** (0.05) | −1.14 (0.77) |
| p-value | 0.248 | 0.004 | 0.142 |
| *wyoung* FWER p-value | 0.576 | 0.022 | 0.438 |
| Age | 0.10*** (0.02) | 0.00* (0.00) | 0.12*** (0.02) |
| $\text{Female}_{(1=\text{yes})}$ | 1.21** (0.47) | 0.11* (0.05) | 1.14 (0.67) |
| Net income | 0.36** (0.13) | 0.03* (0.01) | 0.46* (0.19) |
| $\text{Has uni degree}_{(1=\text{yes})}$ | 0.48 (0.48) | 0.02 (0.05) | 0.44 (0.75) |
| Covid-19 finance(1=yes) | −1.13* (0.53) | −0.11* (0.05) | −0.37 (0.87) |
| $\text{Lives in Mannheim}_{(1=\text{yes})}$ | 0.28 (0.47) | 0.00 (0.05) | 0.70 (0.70) |
| p-value, *Citizen* = *City* | 0.045 | 0.001 | 0.468 |
| Control Mean | 3.47 | 0.44 | 7.87 |
| Observations | 491 | 491 | 238 |
| Adjusted $R^2$ | 0.126 | 0.065 | 0.151 |
| Controls: n/a | Y | Y | Y |

Note: The table displays our main treatment results. Column (1) reports average contributions (in EUR) to the local afforestation project. Column (2) reports the share of positive contributors. Column (3) reports average positive contributions (in EUR) to the local afforestation project. All estimations are based on OLS. Robust standard errors are in parentheses. Below the coefficients, we report the respective p-values, as well as the adjusted p-values, calculated using the Westfall-Young stepdown procedure, which controls the family-wise error rate (FWER) and accounts for dependence among p-values. Since our survey allowed for "no answer" options, we include dummies for these responses. Effects remain robust when we treat dummies as missing, and also use estimations based on Tobit regressions to account for the 0 EUR and 15 EUR bounds of our donation, as well as using Probit instead of OLS (see Supplementary material Table B.4). Significance levels: $^{*}: p < 0.05$, $^{**}: p < 0.01$, $^{***}: p < 0.001$.

group contributed EUR 3, this proportion rises to 6.1 percent in the *City* treatment and 6.9 percent in the *Citizen* treatment. The increase in EUR 3 donations relative to *Control* is statistically significant for both the *City* (Chi-squared test, p-value: 0.042) and *Citizen* (Chi-squared test, p-value: 0.023) treatments. However, there is no statistically significant difference between the *City* and *Citizen* treatments in this regard (Chi-squared test, p-value: 0.787), indicating a comparable response to a potential anchoring effect. Consequently, any observed discrepancies in behavior between these two treatment groups can be ascribed to the reference group manipulation, rather than to anchoring.

### *4.3. Exploratory analysis of treatment effect heterogeneities*

Understanding the heterogeneity of treatment effects is crucial for interpreting the broader implications of our findings. Consequently, we investigate the influence of participants' pro-environmental traits and their identification with the City of Mannheim on their contribution behavior. To identify pro-environmental traits, a set of survey-based variables is employed, including the New Ecological Paradigm (NEP) score, self-reported climate engagement, motivation by the climate actions of others, and political affiliation, as indicated by voting for the Green Party. For the NEP score, climate engagement, and motivation by others' climate actions, respondents are classified into "high" and "low" categories based on their survey responses. The measurement of city identification is achieved through the implementation of six survey-based variables. These variables include respondents' identification with the City of Mannheim, their identification with their district, happiness with their district, involvement in local organizations, knowledge of Mannheim's climate policies, and perception of whether Mannheim's climate actions sufficiently address climate change. Again, respondents are classified into "high" and "low" categories based on their survey responses. This approach allows us to systematically examine how differences in environmental attitudes and identification moderate the effects of our treatments on contribution behavior. We first add the respective environmental and identification variables to our main regression specification as controls. Subsequently, we interact each of these moderator variables with our treatment indicators (*City* and *Citizen* treatments), in order to formally assess the differential treatment effects across subgroups. This approach enables us to systematically assess whether and how individual differences in environmental attitudes and local identification moderate the behavioral response to our treatments.

**Environmental Attitudes:** Table 2 shows that most pro-environmental traits do not change how likely people are to contribute, or how much they contribute on average. However, there is one exception. Participants who report being highly motivated by observing the climate actions of others exhibit a higher likelihood of becoming positive contributors, and their average contributions are correspondingly higher. Thus, it is the dynamic motivation derived from observing others' actions that most strongly predicts contribution. This underscores the potential of leveraging visible climate action as a behavioral nudge within public goods contexts.

The regression analyses, incorporating interaction terms between treatment assignment and environmental traits, reveal statistically significant heterogeneous treatment effects for Green voters in the *Citizen* treatments. These effects are observed for

**Table 2**
Estimation results.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Pro-Environmental Traits | | | City Identification | | |
| | Av. contri (in EUR) | Share (in %) | Pos. contri (in EUR) | Av. contri (in EUR) | Share (in %) | Pos. contri (in EUR) |
| $\text{Treatment}_{\text{Base = Control}}$ | | | | | | |
| *City* | −0.39 | −0.02 | −0.37 | −0.52 | −0.06 | 0.30 |
| | (0.55) | (0.05) | (0.86) | (0.82) | (0.07) | (1.29) |
| *Citizen* | 0.74 | 0.18*** | −1.05 | 0.07 | 0.15* | −2.11 |
| | (0.54) | (0.05) | (0.79) | (0.74) | (0.07) | (1.10) |
| High NEP score | 0.53 | 0.06 | 0.07 | | | |
| | (0.48) | (0.05) | (0.84) | | | |
| Votes green | −0.86 | −0.06 | −0.59 | | | |
| | (0.51) | (0.05) | (0.78) | | | |
| High Climate engagement | 0.11 | 0.03 | −0.22 | | | |
| | (0.58) | (0.06) | (0.73) | | | |
| Highly motivated by others | 1.07* | 0.18*** | −0.09 | | | |
| | (0.53) | (0.05) | (0.76) | | | |
| $\text{High identification city}_{(1=\text{yes})}$ | | | | −0.23 | −0.14 | 2.23* |
| | | | | (0.74) | (0.07) | (1.07) |
| $\text{High identification district}_{(1=\text{yes})}$ | | | | 0.04 | 0.08 | −1.50 |
| | | | | (0.91) | (0.08) | (1.24) |
| $\text{Happy in district}_{(1=\text{yes})}$ | | | | 0.28 | 0.01 | 0.20 |
| | | | | (0.78) | (0.08) | (1.12) |
| $\text{Locally active}_{(1=\text{yes})}$ | | | | −2.02 | −0.25* | −0.11 |
| | | | | (1.33) | (0.13) | (1.65) |
| $\text{Knows climate initiatives}_{(1=\text{yes})}$ | | | | 0.96 | 0.16* | −1.65 |
| | | | | (0.80) | (0.07) | (1.21) |
| $\text{City climate actions enough}_{(1=\text{yes})}$ | | | | −1.24 | 0.01 | −1.14 |
| | | | | (0.84) | (0.10) | (1.09) |
| p-value, *Citizen* = *City* | 0.041 | 0.000 | 0.397 | 0.431 | 0.006 | 0.023 |
| Control Mean | 3.47 | 0.44 | 7.87 | 3.47 | 0.44 | 7.87 |
| Control SD | 5.27 | 0.50 | 5.34 | 5.27 | 0.50 | 5.34 |
| Observations | 491 | 491 | 238 | 277 | 277 | 131 |
| Adjusted $R^2$ | 0.162 | 0.124 | 0.137 | 0.121 | 0.077 | 0.229 |
| Controls: soec | Y | Y | Y | Y | Y | Y |
| Controls: n/a | Y | Y | Y | Y | Y | Y |

Note: The table presents our main treatment results, including additional controls for pro-environmental traits and local identification. Columns (1) and (4) report average contributions (in EUR) to the local afforestation project. Columns (2) and (5) report average positive contributions (in EUR), while columns (3) and (6) report the share of positive contributors. All estimations are based on OLS. Robust standard errors are reported in parentheses. Reported p-values are unadjusted. Adjusting for multiple testing is reported in Supplementary material Table B.7 Socio-economic controls include age, gender, income, university degree, financial hardship due to COVID-19, and residence in Mannheim. Since our survey allowed for "no answer" options, we also include corresponding dummy variables for these responses as controls. Significance levels: $^{*}: p < 0.05$, $^{**}: p < 0.01$, $^{***}: p < 0.001$.

both average contributions (Supplementary material Table B.8) and the share of contributors (Supplementary material Table B.9). In the control group, Green voters are significantly less likely to contribute positively than non-Green voters. When exposed to the *Citizen* treatment, there is a significant increase in the share of contributors by Green voters compared to the control group. The average contribution levels exhibit identical patterns, which are presumably driven by the extensive margin effect. The estimated interaction terms between treatment conditions and the remaining indicators of environmental attitudes (NEP scores, pro-environmental activities, and motivation by others' climate actions) are not statistically significant, suggesting that the treatments do not differentially affect contribution behavior across these subgroups. Furthermore, we find that the *Citizen* treatment is particularly effective at increasing the likelihood of becoming a positive contributor among individuals with initially lower pro-environmental traits. Specifically, the average proportion of contributors among participants with a low NEP score increased by 28.1 percentage points in the *Citizen* treatment compared to the control group (27.2% vs. 55.3%, p<0.001). For participants with a high NEP score, the increase is more modest, at 11.8 percentage points (53.5% vs. 65.3%, p = 0.097). A similar trend emerges when considering climate engagement. In the group of respondents indicating low climate engagement, there was an 18 percentage points increase in the proportion contributors in the *Citizen* treatment compared to *Control* (41.5% vs. 59.5%, p = 0.008). For those with high climate engagement, the increase was only 11 percentage points (57.5% vs. 68.5%, p = 0.329).

**Identification with the City of Mannheim:** Regarding city identification, we find that respondents who report stronger identification with the City of Mannheim are associated with higher positive contributions than those who do not (see Table 2, column (6)). This coefficient is statistically significant in the unadjusted model, but does not remain significant after correcting for multiple comparisons across all covariates (see Supplementary material Table B.7, columns (11) and (12)). We therefore interpret this as a suggestive result consistent with social identity theory, which posits that compliance with group norms and willingness to contribute to collective goods are heightened by a strong sense of shared identity (Terry & Hogg, 2000; Turner et al., 1979). Interestingly, while identification with the city is associated with greater contributions, neither identification with one's district

nor satisfaction with district life has a significant effect. The regression analyses including interaction terms between treatment assignment and identification indicators reveal no statistically significant heterogeneous treatment effects for either the *City* or *Citizen* treatments for most indicators (see Supplementary material Tables B.11–B.13). This result holds across all outcome measures: average contributions (see Supplementary materialx Table B.11), the share of contributors (see Supplementary material Table B.12), and positive contributions (see Supplementary material Table B.13).

**Gender Effects:** Finally, we examine potential gender differences in contribution behavior, motivated by a growing body of research documenting gender-specific patterns in charitable giving and in responses to social information treatments (Croson & Gneezy, 2009; Einolf, 2011; Gneezy et al., 2014; Israel, 2007; Mesch et al., 2011). Our analysis reveals that female participants contribute significantly more than non-females in the control group (see Supplementary material Table B.14, columns (1) and (3)). However, we do not observe any significant differences in treatment effects between gender subgroups; both groups respond similarly to the treatment information.

## 5. Concluding remarks

This study contributes to the growing literature on multi-level climate governance by investigating the interplay between government spending and voluntary citizen contributions to climate action. Using a framed field experiment, we explored whether information about city-level climate efforts influences individual willingness to contribute to a local green public good, either through a potential crowding-out effect or by activating pro-environmental social norms. Our empirical findings offer insights with both theoretical and practical relevance. First, revealing information about City Government spending on climate action does not significantly alter individual contributions. Importantly, we find no evidence of a crowding-out effect: information about public climate spending neither reduces nor displaces voluntary contributions to the local green public good. Thus, showcasing city-level climate efforts does not undermine private engagement — but it also does not stimulate additional voluntary action. Second, contrasting this, highlighting the engagement of fellow citizens increases not only the share of contributors. Total average contributions increased by 9.5 percentage points in the *Citizen* treatment compared to the *City* treatment, with respect to the initial endowment of 15 EUR. This indicates that social norm interventions, particularly those emphasizing descriptive norms within neighborhood networks, can effectively mobilize voluntary climate protection efforts. Furthermore, this approach successfully engages individuals without a strong, pre-existing pro-environmental inclination, broadening the reach of climate action to segments of the population often unreceptive to traditional appeals. Cities aiming to serve as role models for their citizens should therefore actively foster norm-based collaboration within communities. Moreover, in light of the escalating prominence of norm-based interventions, future policy design should carefully evaluate the optimal use of reference-based information in descriptive or injunctive norm messages. We hope that our experimental findings inspire future research on the scalability of social norms in multi-level climate governance.

## Supplementary material

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.joep.2026.102902.

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