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The effect of information framing on policy support: Experimental evidence from urban policies*

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Abstract

Does information influence policy support? We administer a large-scale representative survey with randomised video treatments to test how different policy frames affect citizens' attitudes towards urban tolls in two large European metropolitan areas without tolls, Berlin-Brandenburg and Paris-Ile de France. Providing information on air pollution increases support by up to 11.4%p, information on climate change and time savings increase support by 7.1 and 6.5 %p, respectively. Treatment effects are stronger in the Paris region, where initial support is lower. We also investigate treatment effect heterogeneity across different socioeconomic characteristics as well as by prior beliefs held about the severity of environmental and traffic problems, and we find weak spillovers of our treatment on the support of other policies. Our findings imply that targeted communication of policy co-benefits can increase policy support across different population groups.

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1 Introduction

Urban tolls¹ can effectively address externalities from urban road transport, yet they are rarely implemented. By equalising the marginal private benefits of a trip to its marginal social costs, a first-best congestion price – varying across time and space – implements the logic of Pigouvian price instruments at the level of the city. Next to reducing traffic delays and increasing travel time reliability – their primary motivation from an economic theory perspective [Vickrey, 1969] – congestion prices can also reduce other external costs of urban road transport, such as local air pollution, noise or carbon emissions [Van Dender, 2019]. To date, only a few cities worldwide use price instruments to regulate traffic flows. While prices would vary closely in line with traffic patterns in a first-best setting, even simplified tolling systems have been shown to yield substantial benefits. Where they exist, congestion and cordon pricing systems achieved notable reductions in traffic volumes, accidents, traffic speed increases, as well as reductions in air pollution and health improvements [Croci, 2016, Leape, 2006, Simeonova et al., 2018, Tang, 2021]. While London, Stockholm, Milan, Singapore have successfully implemented congestion taxes or cordon charges, the congestion price in New York City has taken more than a decade to gain traction, and plans to introduce urban tolls were rejected in Edinburgh and Manchester [Eliasson, 2021, Sacks, 2017].

A main barrier to implementing urban tolls is that they are perceived as ineffective or unfair, putting disproportionate financial burden on already disadvantaged groups [Anas and Lindsey, 2011, Gu et al., 2018]. However, the benefits of urban tolls tend to materialise relatively quickly after implementation, which could explain why their popularity tends to significantly increase over time [De Borger and Proost, 2012, Eliasson, 2008, Winslott-Hiselius et al., 2009].² This increase in support can also be explained by the type of benefits emphasised in the public debate. Prior to introduction, the benefits of tolling systems tend to be less visible than their direct financial costs [Anas and Lindsey, 2011]. In contrast, Eliasson [2014] argues that the increase in support for urban tolls in Stockholm was due to the emphasis on improvements in air pollution as opposed to increases in traffic efficiency. Absent real-world experiments, such as actual introduction or trial periods, information provision can serve to make the prospective benefits of a policy more salient. While information has been shown to substantially alter policy attitudes to different tax policies [Stantcheva, 2021], these effects remain unexplored for urban tolls.

In this paper, we explore the effect of different frames of urban tolls on policy support. To this end, we implement a large-scale survey of 4101 urban and suburban households, representative for gender, education and age across the two largest European metropolitan areas without urban tolls, Paris-Ile-de-France and the Berlin-Brandenburg agglomeration. To communicate the benefits of urban tolls to survey respondents, we randomise video treatments of the tolls’ expected effects

¹In this paper, we refer to urban tolls as cordon charges, defined as a fixed access fee to enter a city’s road network. Cordon charges involve charging a fixed fee to enter or drive within a congested area. In contrast, congestion prices typically vary in line with traffic patterns, across place and time of day [Federal Highway Administration, 2022].

²Public support of congestion pricing has been shown to follow a U-shaped curve between the time when the initial decision in favour of implementation is made, to the time when benefits start to appear, with public support of the policy being lowest right before its introduction [Eliasson, 2021].

on air pollution, time savings, and greenhouse gas (GHG) emissions within the survey. The effects of the treatment videos are compared to a control group, which receives a video with largely uninformative content. We investigate treatment effect heterogeneity across the two metropolitan regions, income, urban and suburban residence, mobility behavior, as well as by prior beliefs held about the severity of environmental and traffic problems. We also investigate whether or not our treatment videos influence respondent’s support of other traffic and environmental policies.

We find that urban tolls are very unpopular, more so in Paris-Ile-de-France (P-IdF) than in the Berlin-Brandenburg (B-BB) region. Just 11% of untreated respondents support tolls in P-IdF, compared to 22% in B-BB. All three treatment videos significantly increase policy support. Highlighting the effects of urban tolls on air pollution changes views most strongly, followed by providing information on GHG emissions and time savings. In our preferred specification, the air pollution treatment changes views by 11.4%p. Providing information on urban tolls reducing GHG emissions and commuting time increases support less strongly and in roughly equal magnitudes, by 7.1 and 6.5%p respectively. Targeted information provision changes policy attitudes more strongly in P-IdF where initial support is lower. For example, the air pollution treatment increases support by 13.9%p, compared to 9.3%p in B-BB. On average, urban toll support is higher among households with more education, higher-income households, those living in urban centers, as well as among respondents with a higher trust in state institutions and science. Women and car owners dislike urban tolls more strongly. These differences are largely parallel across the two constituencies investigated, but car owners and females view tolls more strongly negative in B-BB. We identify weak spillovers of viewing a treatment video on the support of other urban and environmental policies. In addition, while there is some variation in treatment effects across socioeconomic characteristics and prior attitudes to traffic congestion, local air pollution and climate change, the small sample sizes caused by using interaction effects do not allow to draw causal inferences.

With the qualification that our intervention is short term, our results suggest that targeted information provision on the potential benefits of urban tolls can increase policy support. Although real-life political communication is less direct, customised information campaigns building on the various benefits of urban tolls targeted at specific population may help increase support for it. More indirectly, arguing for urban tolls as the economically efficient policy might be facilitated by making the benefits of urban tolling policy more salient to the public.

We contribute to a recent but fast-growing body of literature that analyses citizens’ attitudes towards price-based [Stantcheva, 2021] and climate policies – largely carbon taxes – at international [Dechezleprêtre et al., 2022, Fabre et al., 2023, Funke et al., 2023] and national [Carattini et al., 2017, Douenne and Fabre, 2022, Fang and Innocenti, 2023, Klenert et al., 2018, Maestre-Andrés et al., 2021, Sommer et al., 2022, 2023, Sælen and Kallbekken, 2011] level. Some of these papers also randomise information treatments via text or video displays to survey respondents [Carattini et al., 2017, Douenne and Fabre, 2022, Fang and Innocenti, 2023, Sommer et al., 2022, Stantcheva, 2021], identifying the effects of information treatments to compared to a control group. We add to this strand of literature by systematically analysing the effect of targeted information provi-

sion on views towards urban tolls, likewise comparing the effect of information treatments to a control group, including across cities, urban and suburban residents, income and other socioeconomic characteristics. We also contribute to the literature examining attitudes towards urban tolls across different European cities, but largely for smaller cities and without information treatments [Eliasson, 2008, 2014, Janusch et al., 2021, Leape, 2006, Oberholzer-Gee and Weck-Hannemann, 2002]. This is with the exception of Baranzini et al. [2021], who analyse toll support in Geneva. In contrast to their study, our analysis compares two large metropolitan areas. Janusch et al. [2021] investigate toll approval across subjects with heterogeneous time preferences, but in a laboratory setting. We add to this strand of the literature by studying urban toll support in larger metropolitan areas within a survey experiment. On the methodological side, we build on recent advances in the literature on information provision in survey experiments [Haaland et al., 2023, Stantcheva, 2022], with recent applications to study information provision on carbon [Dechezleprêtre et al., 2022, Fang and Innocenti, 2023, Maestre-Andrés et al., 2021] and income and estate tax support [Stantcheva, 2021]. We expand this literature by studying attitudes and beliefs, as well as any changes therein, on a more local policy (urban tolls), using a similar methodological framework.

The remainder of this manuscript is structured as follows. Section 2 describes our experimental design and data, Section 3 develops the key research hypotheses based on previous literature. Section 4 provides an overview of our empirical strategy, before presenting our results in Section 5. Section 6 discusses potential implications of our findings and concludes.

2 Experimental Design and Data

We administer a large-scale online survey to 4101 respondents in the Berlin-Brandenburg (B-BB) and Paris-Ile-de-France (P-IdF) metropolitan agglomerations. For each metropolitan agglomeration, the targeted sample comprised 2000 households, representative for gender, education and age in the respective urban agglomeration.³

2.1 Geographical scope

We include all zip codes in the respective metropolitan agglomerations inside and immediately adjacent to the city centres. This reflects our interest in both urban and suburban populations since both are politically relevant in traffic policy decision-making, due to their commuting patterns. For Berlin, we select all zip codes in the Berlin-Brandenburg agglomeration ("Stadt-Umland-Zusammenhang Berlin-Brandenburg"). For Paris, we choose all zip codes within the Ile-de-France agglomeration.

Figure 2.1 depicts the main administrative divisions in the two metropolitan regions. The two metropolitan areas are roughly similar in structure and commuting patterns, although area

³The relevant data is unavailable for the specific zip codes that we desire, so we use nationally representative data to make up the quota variables. Back-of-the-envelope comparisons between national and subnational averages imply that the differences in proportions across the different strata are small.

Figure 1: Administrative divisions in the two metropolitan agglomerations, Paris Ile de France (left) and Berlin-Brandenburg (right)

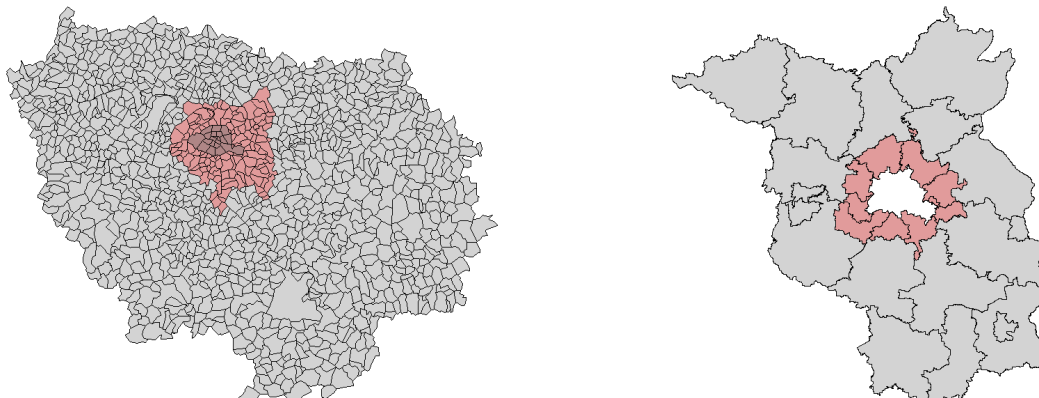


Figure 1 shows the main administrative divisions in the two metropolitan agglomerations, Paris-Ile-de-France (left) and Berlin-Brandenburg (right, "Metropolregion Berlin-Brandenburg"). Within each metropolitan agglomeration, the city centers, as well as the main agglomerations immediately adjacent are highlighted in red. For the Paris area, this corresponds to the "Grand Paris" area, in Berlin this area is called "Berliner Umland".

Source: Amt für Statistik Berlin-Brandenburg (2024, email correspondence), Open platform for French public data (2024). The list of postcodes for Grand Paris was retrieved from Comersis (2024).

and population statistics differ. Both city agglomerations feature a city center with a large circle highway around it (Paris: Boulevard Peripherique, 35km circumference; Berlin: Bundesautobahn A10, 196km circumference), although the circle metro line ("S-Bahn Ring", 37 km circumference) just around the city center is the more meaningful delineation of the inner city border in the case of Berlin, in terms of demographics and political attitudes. In terms of population size, 2.1 million live inside Paris city center while roughly 1.12 live within the inner city ring of Berlin. As of 2022, the wider Ile-de-France region had 12.4 million inhabitants, compared to 6.2 in the Berlin-Brandenburg agglomeration. Thus, population density is a lot higher within Ile-de-France, both within as well as outside of the city center.

2.2 Survey structure and Information Treatments

Our survey contains three main parts, as set out schematically in Figure 2.1. In the first part, we screen for the respective quotas and then ask respondents a suite of questions on key socioeconomic characteristics, personal and political attitudes, and mobility behavior. Within each metropolitan agglomeration, the sample is then randomly divided in four groups, balanced across the three quota variables (gender, age and education). Three of the four groups view video information treatments on the effects of urban tolls on congestion, air pollution or GHG emissions.⁴ The control group views a video containing historical and administrative facts on their respective city and agglomeration.

All three treatment videos contain both quantitative information about the respective issue, and

⁴We decide to show videos, since this method has been shown to increase understanding compared to reading based learning content [Hung et al., 2018].

Figure 2: Survey structure with embedded information treatments

Background and pre-intervention attitudes	Basic socioeconomic characteristics	Age, gender, income, place of residence, education, occupation
	Political views	Trust in institutions, situation on the political spectrum (left-right), cultural worldviews
	Mobility behavior	Car ownership, transport choices (travel mode and timing)
Intervention (<i>mutually exclusive, random allocation but representative by all quota variables</i>)	1) Time savings (n = 1,029)	"A congestion charge reduces time spent in traffic."
	2) Air pollution (n = 1,022)	"A congestion charge reduces local air pollution."
	3) Climate Change (n = 1,025)	"A congestion charge reduces greenhouse gas emissions."
	4) Control (n = 1,025)	Administrative information about metropolitan area.
Post-intervention outcomes and attitudes	Support of congestion pricing, beliefs on behavior changes (own and other), fairness and revenue recycling, other environmental policies	

a narrative component laying out the simple logic of why urban tolls contributes to solving the issue. The first treatment video emphasizes the time savings that arise for commuters when spending less time on congested roads. The second video highlights that urban tolls reduce air pollution and the premature mortality associated with it, thus presenting a health frame. The third video underlines the effects urban tolls have on reducing fuel use and thus mitigating greenhouse gas emissions. The control group is likewise shown a city-specific video, portraying some historical facts about each city, but the contents bear no relation to urban tolls.⁵ The videos are identical across cities, except for language, any city-specific information and city names. The terminology used to name the charge in the videos is "City-Maut" in German and "péage urbain" in French, which for both cases translates to "urban toll" in English. This terminology also corresponds to the words that are used in public debates on the topic.

After viewing the video message and checking whether they have been viewed, the next question asks respondents to consider the introduction of an urban toll in their city, with the following features: in Berlin we posit that a toll would apply to all vehicles driving within the metro circle around the city ("S-Bahn Ring") and in Paris, we ask to consider a toll applying for all cars driving within the "Périphérique", which similarly runs in a circle around the city center. We ask respondents to consider the features of the toll originally introduced in London in 2003 (converted to EUR) in their city, i.e. a daily charge of EUR 7 applying 7:00-18:00 Monday-Friday and 12:00-18:00 Saturday-Sunday and on public holidays and the option for residents within the charging area to apply for a 90 % discount. We then ask subjects whether or not they would support this policy. We further ask a range of questions on revenue use, predicted behavior change and the potential winners and losers of the policy, including in the urban and suburban context, as well as other traffic and environmental policies. The full questionnaire is included in Appendix ?? We partner with the institute respondi/bilendi to carry out the survey in the Berlin and Paris metropolitan areas. The survey was carried out from end of February until the beginning of March 2023.

⁵It is possible that – since the control group receives city-specific information on administrative divisions – their attention might be drawn to the size of their city, which could influence city toll support. If at all, focus on (large) city size will probably positively influence toll support, which would bias our coefficients downwards. Thus, our coefficients presented in Section 5 are conservatively estimated.

2.3 Summary statistics

Table 1 provides summary statistics for the all variables used in our regressions, for the full sample (Column 1), as well as separately for the two metropolitan regions (Columns 2 and 3). Urban toll support in the control group is shown in the first row. The variable is gathered on a Likert scale from 1-5 in the survey, and we re-code to a binary variable showing a respondent as supporting a policy whenever they indicate their support as 4 or 5. 1, 2 and 3 are coded as not supporting the policy. While urban toll support in the control group is 17% across the entire sample, policy support in the control group is much higher in the Berlin-Brandenburg agglomeration (22%) than in Paris-Ile-de-France (11%).

Table 1 also shows the means of our three quota variables⁶ (gender, age and education), income categories, household size and children, hours worked, car ownership, as well as a dummy variable for whether or not the respondent lives in the city center. When comparing Columns 2 and 3 of 1 across the two metropolitan regions, the covariate means of the main socioeconomic characteristics are often close, but not always equal. This is with the notable exception of the share of respondents who live in the city center, which, unfortunately, is highly unequal. We control for these differences in the regressions. We also include region fixed effects in our regressions, to control for any structural differences across the two metropolitan areas (see Section 4 for more detail). Our survey also asks respondents whether or not an individual perceives congestion, air pollution and climate change as problematic prior to treatment (all coded as 0 = yes, 1 = no). These prior beliefs are used as control variables in our regressions, as well as when we analyse narratives and belief changes in Section 5.2.

The survey asks detailed questions on respondent’s attitudes to the environment, trust in institutions as well as cultural worldviews. To summarise them, we construct four indices, building on prior work – including experimental – on the effect of trust and worldviews on policy perceptions and acceptability [Cherry et al., 2017, Dan M. Kahan and Braman, 2011, Dunlap et al., 2000, Janusch et al., 2021]. All indices are standardised for use as control variables in the regressions, but Table 1 displays the unstandardised values. First, we build a trust in institutions index from a question asking respondents how much they trust their city and national parliaments, the police, politicians, scientists, the European Commissions and the United Nations, on a scale from 0 to 10. For the Trust index, we sum up all responses to the nine sub-questions of question P10. The resulting (unstandardised) index runs from a minimum 0 to a maximum of 90. Second, we construct two indices to reflect subjects’ cultural worldviews along two dimensions: Hierarchy–egalitarianism (‘Hierarchy’) and Individualism–communitarianism (‘Individualism’) [Cherry et al., 2017, Dan M. Kahan and Braman, 2011, Janusch et al., 2021]. The Hierarchy index indicates attitudes toward social

⁶Table A1 in the appendix compares our sample data to the population values for the strata we used for randomization, i.e. gender, age and education. Table A1 indicates that our sample largely matches the national population quotas for Germany and France for gender, age and education, although women are slightly overrepresented in our survey in both metropolitan regions, and the group with primary education is too small in Paris-Ile de France. Appendix Table A2 disaggregates the same main socioeconomic characteristics by the different treatment groups, showing that they are rather balanced across treatments. A minor deviation is observed in the case of the time savings treatment, in which the proportion of respondents with primary education is too low.

orderings that link authority to fixed individual characteristics such as gender, race, and class (e.g., ‘Society as a whole has become too soft and feminine’; ‘We need to dramatically reduce inequalities between the rich and the poor, whites and people of color, and men and women’). The Individualism index reflects individual attitudes towards a society that expects individuals to secure their own livelihoods without support – in contrast to attributing the responsibility of securing collective welfare to society (e.g., ‘The government interferes far too much in our everyday lives’; ‘The government should do more to advance society’s goals, even if that means limiting the freedom and choices of individuals’). Questions for the Hierarchy and Individualism index are taken from Cherry et al. [2017]. In line with Janusch et al. [2021] and to facilitate a comparison of results, we code both indices such that higher values imply a more individualistic worldview, and a more hierarchical worldview, respectively. Third, we construct an index on individual’s attitudes towards nature and the environment (‘Nature’), building on an abbreviated version of the survey questions developed in the “New Ecological Paradigm” Dunlap et al. [2000]. The six questions used as inputs for this index ask about the respondent’s beliefs about humanity’s ability to upset the balance of nature, and humanity’s right to rule over the rest of nature. For the Individualism, Hierarchy and Nature indices, subjects indicated agreement or disagreement on a seven-point scale. The scale for the (unstandardised) indices Trust, Individualism, and Hierarchy is from 6 to 42.

Figures A1 and A2 plot the main associations with the four treatment videos across both urban agglomerations. Both figures feature the main messages of the respective treatment videos as the principal words, thus indicating that contents of the treatment videos have been accurately understood by respondents. This is in line with respondents’ affirmative answers as to whether or not they were able to watch and understand the video treatments.

3 Hypotheses

Our analysis allows testing some predictions that emerge from theoretical work on the political economy of urban tolls. These four main hypotheses were pre-registered as AEARCTR-0010783 and they relate to the magnitudes of our estimated treatment effects in the entire sample, as well as across the two metropolitan regions and different socioeconomic characteristics.

Hypothesis 1: *The effect of the air pollution treatment on the support of urban tolls is larger than the effect of the climate change treatment. Highlighting time savings is least effective at changing the acceptance of urban tolls.*

The reasoning underlying this ranking of treatment effect magnitudes is rooted in prior work on the external costs of driving [Anas and Lindsey, 2011, Parry and Small, 2005, Parry et al., 2007], including a more recent literature linking traffic, pollution and health (e.g. Currie and Walker [2011], Simeonova et al. [2018]). While prior research in the economics of road pricing has largely focused

Table 1: Sample summary statistics

	Full sample	B-BB	P-IdF
Urban toll support (in control)	0.17	0.22	0.11
Male	46.23	46.54	45.93
Female	53.43	53.22	53.63
Non-binary	0.341	0.244	0.439
18-29	19.14	17.66	20.62
30-39	19.31	20.73	17.89
40-49	19.19	18.68	19.70
50-59	22.07	23.07	21.06
60-69	20.29	19.85	20.72
Primary education	18.39	19.26	17.50
Secondary education	52.74	56.43	49.05
Tertiary education	28.87	24.29	33.45
Low income (€ < 500-1999)	28.02	26.44	29.60
Middle income (€ 2000 - 4999)	53.40	56.59	50.22
High income (€ 6000 - > 6500)	11.24	11.61	10.87
No response	7.34	5.37	9.31
Center	33.82	32.74	34.97
Rather left	31.02	35.10	26.67
Rather right	35.16	32.17	38.36
Persons per household	1.98	1.86	2.11
Children per household	0.47	0.42	0.51
Workforce participation (%)	0.69	0.73	0.66
Hours worked per week	34.93	34.71	35.18
Owns 1 or more cars	0.76	0.72	0.79
Lives in city center	0.48	0.81	0.15
Belief - congestion	0.25	0.30	0.21
Belief - air pollution	0.22	0.29	0.15
Belief - climate change	0.14	0.19	0.09
Trust	38.60	39.71	37.50
Individualism	25.42	25.94	24.90
Hierarchy	21.01	20.70	21.32
Nature	15.60	15.14	16.06
<i>N</i>	4101	2050	2051

This table shows means of all variables used in our estimations, for the full sample, as well as separately for each metropolitan region (Berlin-Brandenburg (B-BB) and Paris-Ile de France (P-Idf). The urban toll support variable is gathered on a Likert scale from 1-5. We re-code a respondent as supporting a policy whenever they indicate their support as 4 or 5. 1, 2 and 3 are coded as not supporting the policy. Gender and age and income are reported and grouped as self-identified within the survey. Education levels are grouped according to the International Standard Classification of Education (ISCED). Income was gathered in smaller categories, which have been aggregated into three main categories (low, middle, high). When income is not reported, it is omitted in the regressions. Political self-identification was collected on a scale from 0 to 10, where 5 is taken as center, values 0 to 4 are coded as "rather left" and value 6 to 10 are coded as "rather right. Number of persons and children per household is a simple count. Workforce participation and hours worked are coded from a question asking about whether or not a respondent works and how many hours. Car ownership and place of residence (=zip code) are directly taken from the survey. Beliefs in whether or not congestion, air pollution and climate change are problematic are reported as gathered in the survey. The Trust, Individualism, Hierarchy and Nature index are constructed from questions P10, P1, P3 and P3-P8, respectively. The Trust index is coded such that higher values indicated higher trust in institutions. The Individualism and Hierarchy index are coded such that higher values imply a more individualistic, and a more hierarchical worldview, respectively. The Nature index is coded such that higher values imply more control over nature.

on congestion relief as the main benefit of tolls, public perception of the instrument appears to rate environmental quality as a key problem and improvements thereof as the main benefit associated with the introduction of urban tolls [Oberholzer-Gee and Weck-Hannemann, 2002]. Nevertheless, time savings from reduced congestion can be important for some commuters. Reduced fuel use from driving as a result of an urban toll is probably a less relevant consideration, since driving is probably perceived as a rather small contribution to the greenhouse gas effect and climate change, a global externality [Anas and Lindsey, 2011].

Hypothesis 2: *Support for tolls is increasing with the severity of air pollution. Since air pollution is more pervasive in Ile-de-France, this implies that the treatment effect of the "air pollution" video is larger in Ile-de-France than in the Berlin agglomeration, in the context of our analysis.*

The Ile-de-France region routinely experiences episodes exceeding the EU limits for nitrogen dioxide (NO₂) and particulate matter (PM) during winter and early spring [Font et al., 2019]. During these pollution episodes, the city often implements highly salient emergency measures to combat air pollution, such as speed restrictions, banning heavy duty vehicles in the inner city, providing free or reduced cost public transportation, or free residential parking [Font et al., 2019]. While Berlin also suffers from air pollution, NO₂ and PM values are much lower, and the problem is much less prominent in local public discourse [Khomenko et al., 2021]. We hence expect the response to the effects of a congestion charge on air pollution to be much stronger in the Paris than the Berlin agglomeration.

Hypothesis 3: *Treatment effects vary across urban and suburban populations.*

- *The treatment effect of the "time-savings" video is stronger among the suburban population, since they are likely to commute longer distances and spend more hours in traffic.*
- *The treatment effect of the "air pollution" information is smaller for individuals in suburban areas, as they are less likely to benefit from any reductions in air pollution.*
- *The treatment effect of the video on the effect of urban tolls on greenhouse gas emissions is the same across rural and urban individuals (controlling for socioeconomic variables and environmental attitudes).*

Individuals living and working in the densely populated urban core, and those living in less dense suburban areas who commute to the urban core, are differently affected by urban tolls Fageda et al. [2022]. While individuals traveling to the urban centre from suburban areas commute longer distances, and benefit less from air pollution improvements in the city center, urban residents have better access to public transport, and are more likely to feel air quality improvements. In contrast, since climate change is not a local externality, reductions in fuel use and thus GHG emissions affect

urban and suburban residents equally.

Hypothesis 4: *Lower-income households support urban tolls less, due to the perceived regressive effects of the policy.*

There are several reasons for this hypothesis: First, as with other energy goods, existing research finds that road pricing has first-order regressive monetary effects, prior to revenue recycling [Anas and Lindsey, 2011]⁷ Second, a further reason is that high-income travelers gain from the tolls because they value time savings highly relative to the toll they pay [Small, 1983, 2012]. Third, even irrespective of actual toll incidence in money (and the effects of revenue recycling), the policy is likely to be perceived as regressive by constituents, perhaps also due to lower trust in the implementation or effectiveness of recycling measures [Anas and Lindsey, 2011]. As a result, we hypothesise that low-income households will support urban tolls less.

In addition to these main hypotheses, the research design allows testing additional hypotheses relating to interactions of these main hypothesized effects with several individual characteristics, such as political attitudes and mobility behavior, similarly examined below.

4 Empirical Strategy

We are interested in measuring the effect of different types of policy framing on support for an urban toll. The random allocation of households to experimental treatment groups allows us to identify the causal treatment effect using a linear probability model with the following specification:

$$y_{ic} = \alpha + \beta_1 T_i + \beta_3 X_i + \theta_c + \epsilon_{ic}, \quad (1)$$

where y_i is a binary variable that equals unity if respondent i in city c states that she supports an urban toll and zero otherwise. $T_i \in [1, 2, 3, 4]$ is a treatment indicator for each treatment or control group, and ϵ_{ic} is a random error term. In some specifications, we include a vector of socioeconomic controls X_i , as specified below. The differences between covariates observed across the different metropolitan regions in Table 1 motivate our use of region fixed effects θ_c , to control for any latent or structural differences between the two metropolitan regions, in addition to the control variables. We take the most stringent specification of Equation (1) with region fixed effects and socioeconomic controls as our preferred specification, to get at the causal effect of the treatment variables on policy support, β_1 . Equation 1 allows testing our first hypothesis, namely the differential effects of the respective treatments T_i on policy support. All effects are measured relative to the control treatment. In addition to the treatment effect, we are also interested in the signs and magnitudes of the different coefficients of the control vector X_i , since they allow us to compare policy support across socioeconomic characteristics.

⁷Nevertheless, Santos and Rojey [2004] show that the incidence of urban tolls strongly depends on the spatial distribution of income and the locations of residences, workplaces, and other travel destinations.

In addition, we quantify heterogeneous treatment effects by including interaction terms between socioeconomic characteristics and treatment group indicators:

$$y_i = \alpha + \beta_1 X_i + \beta_2 T_i + \beta_3 T_i \times X_i + \theta_c + \varepsilon_i, \quad (2)$$

where y_i , T_i , X_i and ε_i are specified as in Equation (1). Our main effect of interest is β_3 , the coefficient on the interaction between the socioeconomic variables and the treatments.

5 Results

This section first presents our main result on the effect of our information treatments on the support of an urban toll. We then turn towards examining treatment effect heterogeneity across a range of socioeconomic characteristics (Section 5.1), as well as on beliefs held about the potential effects of an urban toll (Section 5.2).

Table 2 shows the results of estimating Equation (1), using a binary variable of urban toll support as dependent variable. Model 1 estimates Equation (1) on the full sample, without socioeconomic controls or region-fixed effects. All three coefficients of the information treatments are positive and statistically significant at the 1% level, but magnitudes vary across treatments.⁸ Framing an urban toll around the benefits that arise due to reductions in air pollution increases policy support by 10.3%p. The treatment effects of framing an urban toll introduction around reductions in GHG emissions and time savings are smaller and of roughly equal magnitude, at 6.05%p and 5.18%p, respectively. Models 2 and 3 add socioeconomic controls and region fixed effects to the specification, but the magnitude and statistical significance of the treatment effects remain largely unchanged. This ordering of the magnitude of treatment effects (air pollution > climate change > time savings) is largely in line with the first hypothesis described above and as registered in our pre-analysis plan, although we had hypothesized that all coefficients would be different from each other, whereas the treatment effects of the climate change and time savings are statistically not distinguishable from each other.

Models 4 and 5 in Table 2 estimate Equation 1 separately for the Berlin-Brandenburg and Paris-Ile de France metropolitan regions, respectively. They thus allow comparing treatment effects across the two metropolitan agglomerations. Magnitude and statistical significance of the information treatments differ across the two regions. In Model 4 (for B-BB), just the air pollution treatment causally increases policy support, by 9.29%p), whereas the other two treatments are statistically insignificant. In contrast, all three treatment videos have significant effects on support for an urban toll in Model 5 for P-IdF. In P-IdF, providing information on air pollution, climate change and time savings increases support by 13.9, 12.3 and 10.4%p, respectively. Thus, treatment effects differ across the two metropolitan regions, and they are larger in magnitude in P-IdF than in B-BB.⁹ This

⁸F-test for differences across coefficients allow us to reject the null hypothesis of equal coefficients for the air pollution treatment. The coefficients for the time savings and climate change treatments are statistically different from the control group, but they are not statistically different from each other.

⁹We use seemingly unrelated estimation and a Hausman test to test whether the coefficients from models 4 and

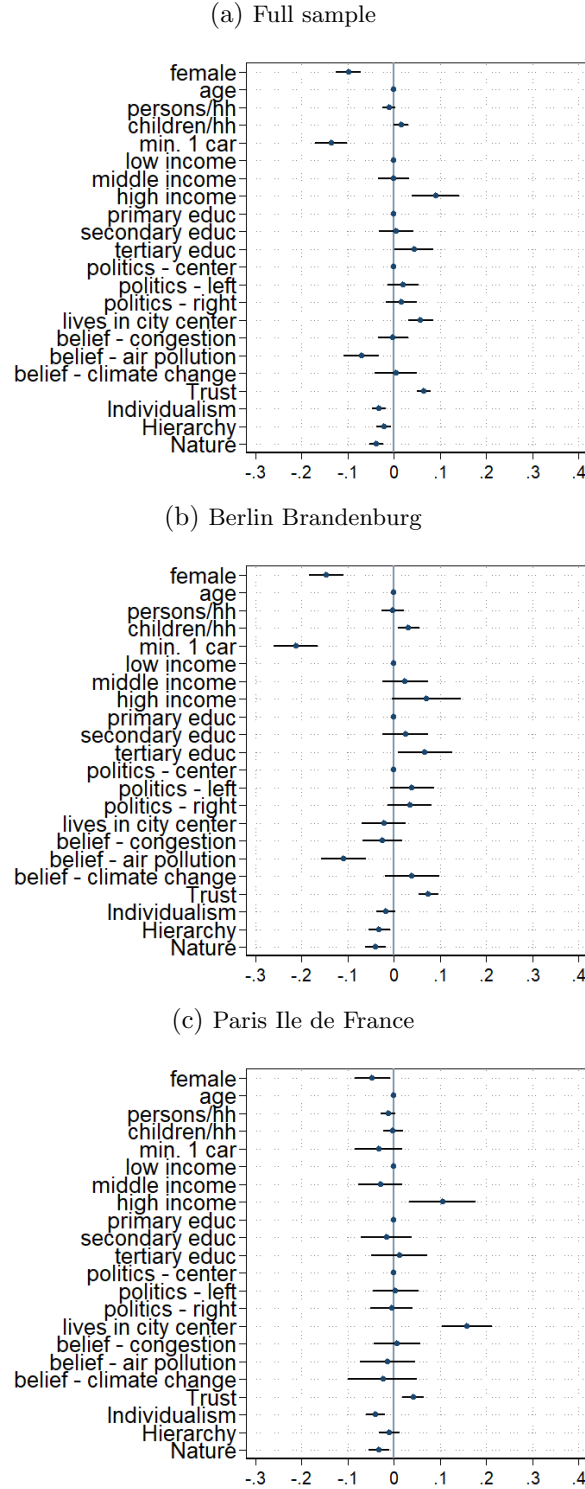
is all the more interesting as policy support in the control group is higher in Berlin-Brandenburg (as described in relation to Table 1), the effect of the information treatments on views is more moderate. In contrast, support for an urban toll is much lower in Paris-Ile de France, but the information treatments have a stronger effect on changing views than in the Berlin-Brandenburg region.

The magnitude of our estimated treatment effects are in line with, but at the larger end of the range of estimated treatment effects in similar analyses. Baranzini et al. [2021] investigate the effect of showing a text on congestion and air pollution on policy support to 1500 survey respondents in Geneva. In contrast to us, Baranzini et al. [2021] are mainly interested in testing the support of different charging designs. While policy support for an urban toll in the control group is a lot higher in their case (around 50%), their treatment effects are a lot smaller in magnitude – between 4 and 5%p for the air pollution treatment, and insignificant for the congestion treatment. It is hard to ascertain whether these differences are due to survey design (e.g. video vs text treatments) or due to the demographics of the underlying population (e.g. higher *ex ante* support). Dechezleprêtre et al. [2022] show survey respondents video information treatments on climate policies and climate impacts, and test subsequent support of a range of climate and environmental policies, with estimated treatment effects between 0 and 15%p. Stantcheva [2021] tests the effect of video information treatments on the redistributive and efficiency effects of income and estate taxes on the perceived behavioral responses to tax evasion, finding treatment effects of up to 18%p.

Figure 3 plots the magnitude and confidence intervals of the control variables used in Equation 2, from our preferred specification with controls and region fixed effects. Panel A plots the magnitudes of the control variables for the full sample. While many of the control variables are not statistically significant, having acquired tertiary education, being a high-income earner, living in the city center, as well as a higher trust in institutions are positively associated with support for an urban toll. Car owners and women support urban tolls less. In addition, rating that air pollution is "not problematic", as well as a more individualistic and hierarchical worldview, including over human interference in nature, are negatively associated with urban toll support. Panels B and C of Figure 3 plot the coefficients of the control variables from estimating Models 4 (for Berlin-Brandenburg) and Model 5 (Paris-Ile de France, Panel B). Comparing the two panels, there are some noticeable differences in the magnitude and statistical significance of the coefficients across the two regions. Owning a car is strongly negatively associated with urban toll support in the Berlin-Brandenburg region, but not in Paris-Ile de France. Living in the city center and having a high income is strongly positively associated with urban toll support in Paris-Ile de France, whereas it does not correlate with urban toll support in Berlin-Brandenburg. In addition, the magnitude of the "female" coefficients is much smaller in the French capital region.

6 are indeed different. We can reject the null hypothesis of no difference.

Figure 3: The effect of information treatments on urban toll support - coefficient plot



This Figure plots the coefficients of control variables from estimating Equation (1), with region fixed effects. The dependent variable is support for an urban toll. Urban toll support is coded as a binary variable, which equals 1 if a respondent states that they support the introduction of an urban toll in their city. Control variables are defined as a female dummy, the number of persons per household (continuous), the number of children per household (continuous), a respondent's stated income group (low, middle, high, as defined in Table 1), a respondent's stated education group (primary, secondary, tertiary), political orientation (rather left, rather right, center), a dummy for urban residence, pre-treatment beliefs in whether or not congestion, air pollution, and greenhouse gas emissions are problematic, as well as four indices on trust and cultural worldviews.

Table 2: The effect of information treatments on urban toll support

	(1)	(2)	(3)	(4)	(5)
	Full sample	Full sample	Full sample	B-BB	P-IdF
Time savings	0.0518*** (0.0184)	0.0513*** (0.0184)	0.0654*** (0.0188)	0.0245 (0.0261)	0.105*** (0.0267)
Air pollution	0.103*** (0.0184)	0.103*** (0.0184)	0.114*** (0.0188)	0.0929*** (0.0263)	0.139*** (0.0266)
GHG	0.0605*** (0.0184)	0.0604*** (0.0184)	0.0705*** (0.0188)	0.0252 (0.0264)	0.123*** (0.0266)
Controls			Yes	Yes	Yes
Region FE		Yes	Yes		
N	4101	4101	3620	1868	1752

This table shows the results of estimating Equation 1, using support for an urban toll as a dependent variable. We code urban toll support as a binary variable, which equals 1 if a respondent states that they support the introduction of an urban toll in their city. The different columns in Table 1 show different model specifications. Model 1 estimates Equation 1 on the full sample with no fixed effects or control variables. Model 2 estimates Equation 1 including region fixed-effects, Model 3 adds control variables. Models 4 and 5 estimate Equation 1 separately for Berlin-Brandenburg and Paris-Ile de France. Control variables include a female dummy, persons per household, children per household, income, education, car ownership, political orientation (rather left, rather right, center), place of residence (urban or rural), pre-treatment beliefs in whether or not congestion, air pollution, and greenhouse gas emissions are problematic, as well as a trust index, and three indices on cultural worldviews. Standard errors are shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

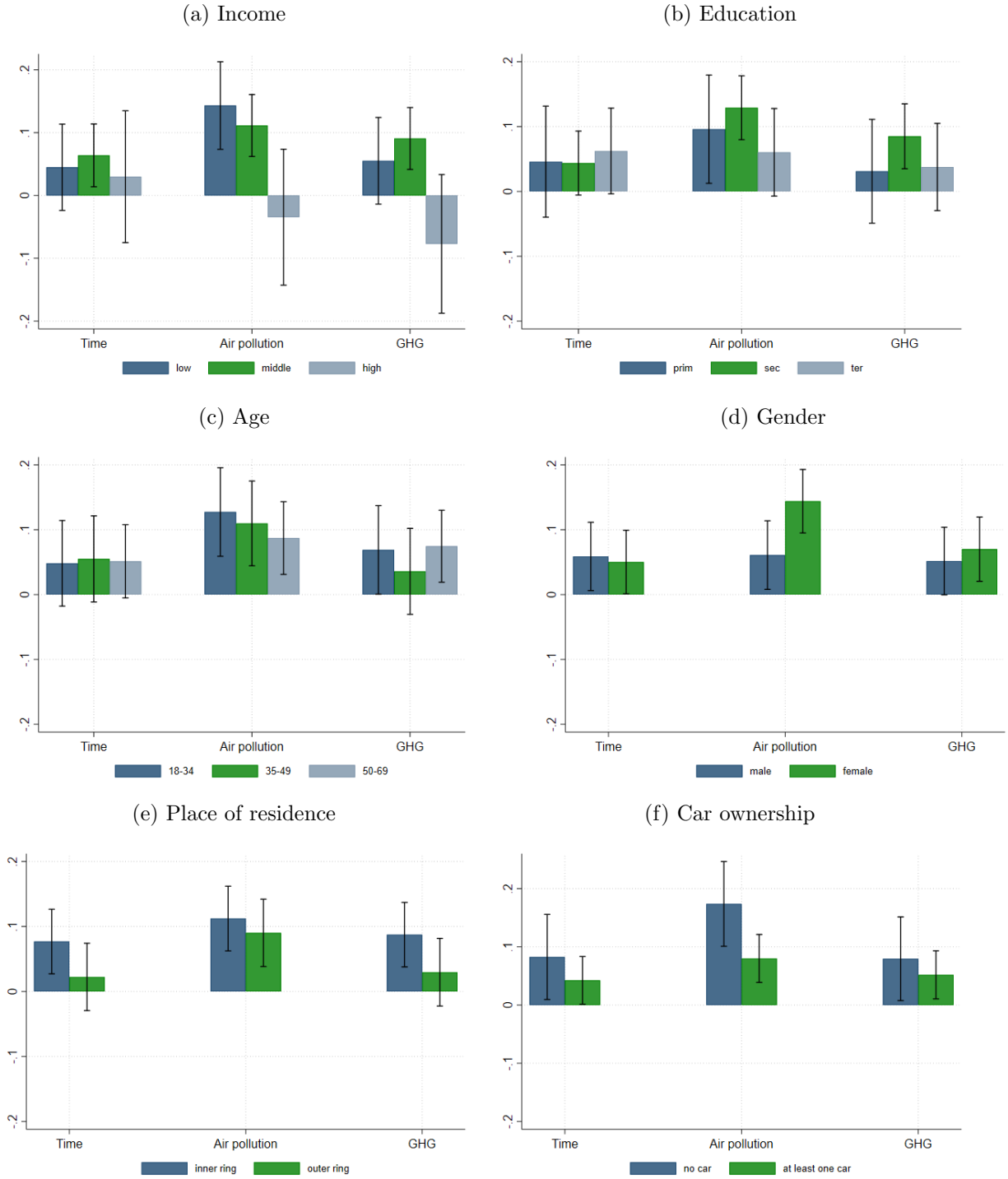
5.1 Socioeconomic characteristics

Figure 4 displays the marginal treatment effects from estimating Equation (2) with interactions for different subgroups of our sample. Panel A (top left) examines treatment effects with regards to differences across income groups (low, middle, high, as defined in Table 1). Panels B, C, D, E and F disaggregate treatment effects with respect to education, age, gender, residence in- and outside of the urban centers as well as car ownership. In general, due to the relatively small sample sizes that result from dividing the sample by the different subgroups within each income bracket, the signal associated with the individual coefficients is relatively low. Treatment effect magnitudes and confidence intervals overlap in most panels. Thus, differences in treatment effects can not be established with sufficient certainty in most cases. This is with the exception of responses to the air pollution treatment, in the case of income (Panel A), as well as car ownership (Panel D). Panel A indicates that respondents with a lower income respond more strongly to the air pollution treatment than those with higher incomes. Panel D indicates that respondents without a car respond more strongly to the air pollution treatment compared to respondents that own cars.

5.2 Beliefs

Prior to treatment, we elicit whether respondents perceive congestion, air pollution and climate change as serious issues (P13, P14, P15). While we control for these prior beliefs in the regressions

Figure 4: Urban toll support and treatment effects across selected socioeconomic characteristics



This Figure shows the results of estimating Equation (2), using support for an urban toll as a dependent variable, with different socioeconomic interaction variables. Urban toll support is coded as a binary variable, which equals 1 if a respondent states that they support the introduction of an urban toll in their city. The panels disaggregate treatment effects by income group (a), education level (b), age (c), gender (d), urban or suburban residence (e), and whether or not the respondent's household owns at least one car (f).

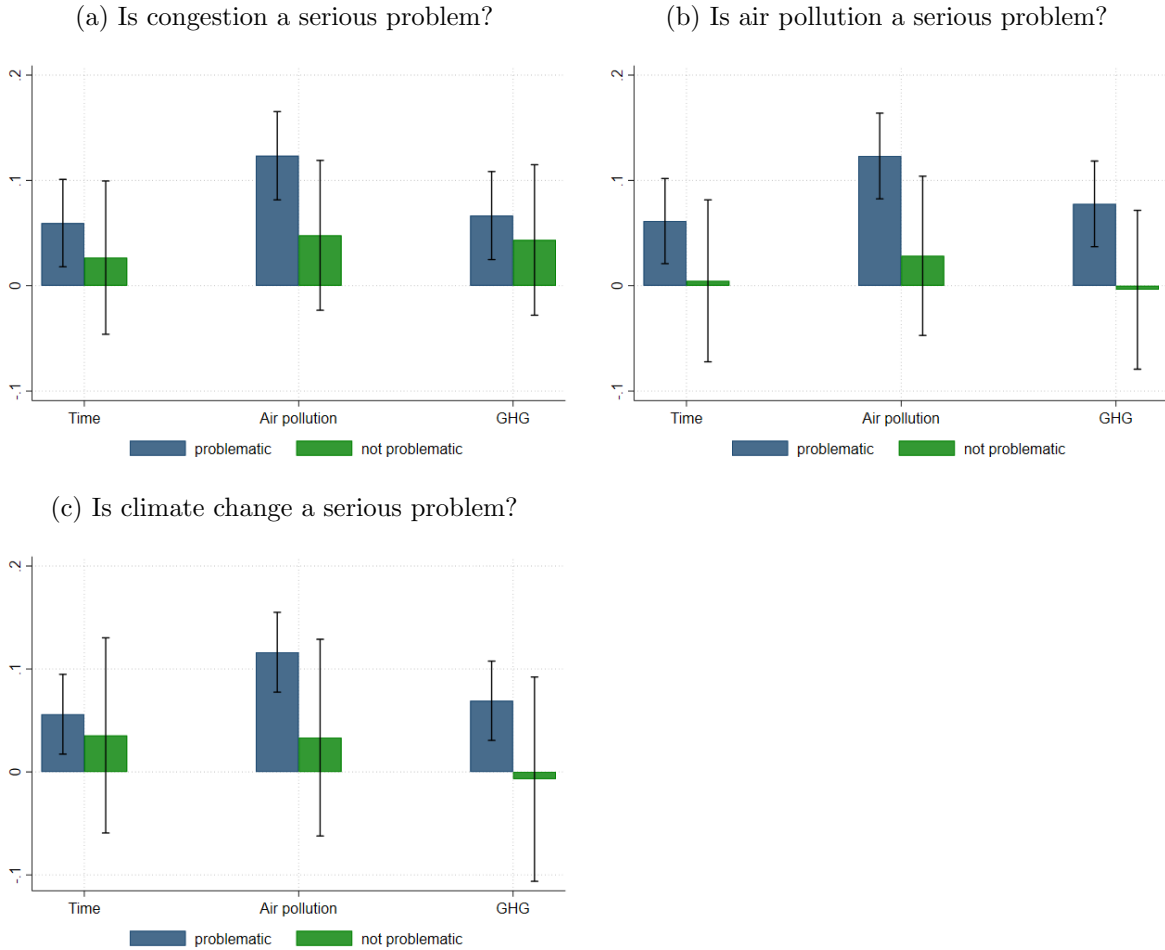
discussed in prior sections, treatment effects may vary in line with these prior beliefs. We thus use these prior beliefs as interaction variables to estimate Equation (2). The results of that exercise are shown in 5. Panel A disaggregates policy support by whether or not a respondent perceives congestion as problematic or not, panels B and C disaggregate support by whether or not respondents believe air pollution and GHG emissions to be a serious problem. However, while the mean point estimates are different, the confidence intervals all overlap. This is largely due to small group sizes, particularly due to the small proportions of respondents that have indicated these issues *not* to be problematic.

In a similar vein, we are interested in knowing whether or not the treatments affect respondent's belief in the effects resulting from an urban toll. Table (3) shows the results of estimating Equation 1 using respondents' beliefs on the behavioural effects of urban tolls across treatment groups as a dependent variable. The different outcome variables equal unity wherever a respondent rates the specific outcome as likely, and zero otherwise. Model 1 regresses whether or not a respondent believes that the effect of an urban toll would be to reduce driving on the treatments, with largely statistically insignificant results. Model 2 of Table 3 uses respondents' belief that an urban toll will reduce air pollution as a dependent variable. All coefficients on the treatments are of roughly the same order of magnitude and highly significant. Thus, regardless of the treatment group, respondents believe that an urban toll reduces air pollution. The same is true for Model 3, which uses respondents' belief in urban tolls resulting in GHG reductions as a dependent variable. In Model 4, which takes respondent's belief of whether or not an urban toll will affect driving speed as the dependent variable, the time savings treatment is significant at the 1% level, but the other coefficients are insignificant. The pattern of results seen in 3 could indicate that most respondents believe in the effectiveness of an urban toll in reducing pollution and GHG emissions anyways, i.e. regardless of treatment, but that they may not be as aware of the benefits of urban tolls for time savings. These results run counter the conventional view in transport economics that a key motivation for the introduction of urban tolls is time savings [Anas and Lindsey, 2011, Oberholzer-Gee and Weck-Hannemann, 2002].

5.3 Spillovers

Treatment effects might spill over on the perceptions of other policies. For instance, viewing information on the health effects of local air pollution might affect the perception of a low-emissions zone in cities, or the necessity of more stringent fuel standards. To test for these effects, the last part of the survey (Question C16) introduces a Low Emissions Zone (LEZ) to survey respondents, and questions C17 and C18 ask for support of other transport (more stringent fuel standards, better bike lanes, better public transport, higher parking fees) as well as environmental policies (a carbon tax with a refund, a low-carbon subsidy, an tax on airline tickets, and a beef tax), respectively. We are interested in whether or not there was an association between viewing a certain treatment video

Figure 5: Urban toll support and treatment effects by prior beliefs



This Figure shows the results of estimating Equation (2), using support for an urban toll as a dependent variable, with interaction variables. Urban toll support is coded as a binary variable, which equals 1 if a respondent states that they support the introduction of an urban toll in their city. The panels disaggregate treatment effects by whether or not a respondent believes that congestion (a), air pollution (b), and greenhouse gas emissions (c) are problematic.

Table 3: The effect of information treatments on beliefs about the effects of an urban toll

	(1)	(2)	(3)	(4)	(5)
	Drive less	Pollute less	Emit less GHG	Drive faster	Less accidents
Time savings	0.0162 (0.0231)	0.0950*** (0.0227)	0.0730*** (0.0230)	0.158*** (0.0212)	0.0548** (0.0228)
Air pollution	0.0389* (0.0231)	0.0797*** (0.0227)	0.0755*** (0.0230)	0.0374* (0.0212)	0.0549** (0.0228)
Climate change	0.0110 (0.0231)	0.0824*** (0.0227)	0.0665*** (0.0230)	0.0336 (0.0212)	0.0440* (0.0228)
Controls	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observations	3620	3620	3620	3620	3620

This table shows the results of estimating Equation 1, using respondent’s beliefs in the likelihood of different behavioral changes as a dependent variable. Control variables include a female dummy, persons per household, children per household, income, education, car ownership, political orientation (rather left, rather right, center), place of residence (urban or rural), pre-treatment beliefs in whether or not congestion, air pollution, and greenhouse gas emissions are problematic, as well as a trust index, and three indices on cultural worldviews. Standard errors are shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

on the support for these policies. Table 4 regresses respondent’s support of other transport policies on the treatments. While we had expected an effect of the air pollution video on LEZ support, there is no significant effect. With the exception of an weak effect of viewing the video on time savings on the support for higher parking fees (p-value 10%), all coefficients are insignificant. The same is true when regressing the support of other policies on the different treatment groups. While we see some weak effects of viewing the video on the health effects of air pollution and greenhouse gas emissions on support for a low-carbon subsidy, no other coefficients are significant. Although our intervention is short-term, the fact that we find a weak spillover effect of our treatments on the attitudes towards other transport and environmental policies could be an indication of our intervention being remembered until the end of our survey, at least.

6 Conclusion and Discussion

We implement a large-scale survey of a total of 4101 urban and suburban households, representative for gender, education, and age across the Berlin-Brandenburg and Paris-Ile-de-France regions, the two largest European urban agglomerations without toll. To test how different frames of urban tolls influence support, we randomise treatment videos to respondents, which communicate the effects of an urban toll on air pollution, time savings or greenhouse gas emissions. The effects of

Table 4: The effect of information treatments on support of other urban transport policies

	(1) LEZ	(2) Fuel standards	(3) Bike lanes	(4) Better public transport	(5) Higher parking fees
Time savings	0.0310 (0.0218)	0.0166 (0.0211)	0.0240 (0.0219)	-0.00947 (0.0161)	0.0402** (0.0169)
Air pollution	0.0140 (0.0217)	0.0100 (0.0211)	-0.0160 (0.0218)	-0.00894 (0.0160)	0.0314* (0.0169)
GHG	0.0273 (0.0217)	0.0192 (0.0211)	0.00390 (0.0219)	-0.00375 (0.0161)	-0.00623 (0.0169)
Controls	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes
N	3495	3620	3620	3620	3620

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This table shows the results of estimating Equation 1, using support for different transport policies as a dependent variable. Control variables include a female dummy, persons per household, children per household, income, education, car ownership, political orientation (rather left, rather right, center), place of residence (urban or rural), pre-treatment beliefs in whether or not congestion, air pollution, and greenhouse gas emissions are problematic, as well as a trust index, and three indices on cultural worldviews. Standard errors are shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: The effect of information treatments on support of other environmental policies

	(1) Carbon tax w/ refund	(2) Low-carbon subsidy	(3) Airline ticket tax	(4) Beef tax
Time savings	-0.0114 (0.0166)	0.0202 (0.0215)	0.00208 (0.0212)	0.0133 (0.0167)
Air pollution	-0.0244 (0.0166)	0.0437** (0.0214)	0.0315 (0.0211)	0.0318* (0.0167)
GHG	-0.00335 (0.0166)	0.0519** (0.0215)	0.00406 (0.0212)	0.0135 (0.0167)
Controls	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Observations	3620	3620	3620	3620

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

This table shows the results of estimating Equation 1, using support for different environmental policies as a dependent variable. Control variables include a female dummy, persons per household, children per household, income, education, car ownership, political orientation (rather left, rather right, center), place of residence (urban or rural), pre-treatment beliefs in whether or not congestion, air pollution, and greenhouse gas emissions are problematic, as well as a trust index, and three indices on cultural worldviews. Standard errors are shown in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

the treatment videos on acceptance are compared to a control group, which watches a video with content unrelated to urban tolls, as a baseline.

Urban tolls are unpopular, with 11% of the respondents supporting the policy in P-IdF and 22% in B-BB, yet, providing targeted information can increase it substantially. As we hypothesized, the air pollution treatment changes views most strongly, by 11 percentage points. Providing information on urban toll reducing GHG emissions, and the time savings resulting from urban tolls also increases support, by 7 and 6 percentage points, respectively. Our average treatment effects of between 5 and 10 percentage points, roughly, are in line with previous literature using survey experiments with treatment videos Dechezleprêtre et al. [2022], Stantcheva [2021]. Although with a focus on the charging amount and charge design, Baranzini et al. [2021] also find that providing information on air pollution increases support by more than providing information on congestion reductions. Nevertheless, for P-IdF specifically we find that an increase by 14 percentage points for the air pollution treatment is a large effect, compared to similar interventions.

The treatment effects for P-IdF are much larger in magnitude than in B-BB. While the mechanism driving this change remains unclear, it may be that the Parisian population remains less informed about potential co-benefits of urban tolls (and the information thus had a larger marginal impact), or that the videos eroded initial skepticism on price-based instruments. In line with our second hypothesis, the air pollution treatment increases support much more in P-IdF, by 13.9%p, compared to 9.3%p in B-BB. A potential reason is that local air pollution is a very salient feature in Paris, with emergency measures to combat it being implemented relatively regularly [Font et al., 2019].

We observe differences in average support levels by income and education. In line with our expectations, support for urban tolls is higher among households with larger incomes and higher education, as well as among urban constituents. Due to the regression specification with interaction effects, the sample sizes within each of these subsamples are too small to ascertain causality.

Using respondents’ beliefs in behavioural changes as an outcome variable, substantial variation across the treatment groups exists: while belief in the effects of an urban toll on local air pollution and GHG is constant and significant across treatment groups, respondents which have seen the video on time savings are much more confident in the effects of urban tolls on traffic speed. It could be that the effects of an urban toll on time savings are more unintuitive or unknown to households than its environmental effects. In that case, the specific information provided in the treatment videos, or the increase in the salience of the information could explain why those videos still contribute to increases in support.

Can these results be extrapolated to real-world politics? Two broader implications could follow from our results, the first more and the second less direct. First, real information campaigns on urban tolls – for example, shown via ads next to busy streets, just like election campaigns – are probably less salient than a video message, and so their effects on changing views are generally weaker, even if the included priming can sometimes have lasting effects [Carter et al., 2011]. Yet, our work suggests they may be worthwhile if there are direct benefits for those targeted, as is the

case with urban tolls. They could be relatively targeted, for example, by varying information in urban and suburban contexts, or across less and more affluent areas, especially by digital means of communication. Information campaigns would then add to the expenses associated with the introduction of urban tolls [Mattauch et al., 2022], however, the more targeted the campaigns, the more costs would decrease.

Second, our results on which frames can elicit greater support for urban tolls document that the perception of the public differs from that of standard economic theory. This suggests to combine economic rationality with appeals to the unconvinced in giving policy recommendations. The more indirect implication of our work is hence that economists could advocate in public debates for effective policies on grounds more easily understood by citizens and politicians alike [Ambuehl et al., 2023, Marshall et al., 2018] to generate more societal support.

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Appendix

A1 Supplementary tables and figures

Table A1: Sample and population summary statistics of quota variables

	Total		Sample		FR		Population	
	Freq.	%	Freq.	%	Freq.	%	DE	FR
Gender								
Male	1896	46.23	954	46.54	942	45.93	50.46	48.98
Female	2191	53.43	1091	53.22	1100	53.63	49.54	51.02
Non-binary	14	0.341	5	0.244	9	0.439	-	-
Age group								
18-29	785	19.14	362	17.66	423	20.62	19.76	21.56
30-39	792	19.31	425	20.73	367	17.89	19.40	20.01
40-49	787	19.19	383	18.68	404	19.70	17.97	20.01
50-59	905	22.07	473	23.07	432	21.06	23.74	20.55
60-69	832	20.29	407	19.85	425	20.72	19.12	18.64
Education								
Primary	754	18.39	359	17.50	359	17.50	18.4	25.5
Secondary	2163	52.74	1006	49.05	1006	49.05	58.0	43.8
Tertiary	1184	28.87	686	33.45	686	33.45	23.5	29.9
N	4101	-	2050	-	2051	-	-	-

This table contains key sample summary statistics for gender, age and education groups for the full sample, as well as separately for the Berlin-Brandenburg and Paris Ile-de-France areas. The table also contains national averages for France and Germany for these same variables. The sample statistics are from our survey, national average values are from Eurostat.

A2 Video Messages

Broadly, the video messages have the following content:

1. Time-savings: While commuting to work, citizens lose time travelling on congested roads. A solution to reduce driving and tackle congested roads is to introduce an urban toll. A reduced number of cars on the road improves traffic flow, allowing the remaining cars travel at faster speeds.
2. Air pollution: Motorised vehicles are an important source of air and noise pollution, causing a number of diseases. A solution to reduce driving and tackle air pollution is to introduce an

Table A2: Distribution of covariate values by treatment group

	(1)	(2)	(3)	(4)
	Control	Time savings	Air pollution	GHG
	Percent	Percent	Percent	Percent
Male	47.22	45.58	44.91	47.22
Female	52.59	54.13	54.79	52.20
Non-binary	0.195	0.292	0.294	0.585
Primary Education	19.61	15.84	17.51	20.59
Secondary Education	51.90	53.74	54.40	50.93
Tertiary Education	28.49	30.42	28.08	28.49
Low-income	26.54	29.15	27.59	28.78
Middle-income	54.05	50.92	54.31	54.34
High-income	11.51	12.34	10.96	10.15
No response	7.902	7.580	7.143	6.732
	Mean	Mean	Mean	Mean
Persons per HH	1.99	1.98	2.01	1.96
	(0.95)	(1.00)	(1.07)	(1.16)
Children per HH	0.45	0.50	0.45	0.46
	(0.83)	(0.89)	(0.80)	(1.03)
Workforce participation	0.70	0.70	0.70	0.68
	(0.46)	(0.46)	(0.46)	(0.47)
Hours worked	35.18	34.86	34.83	34.85
	(6.70)	(7.61)	(7.60)	(7.57)
At least 1 car	0.76	0.76	0.76	0.74
	(0.43)	(0.43)	(0.43)	(0.44)
Spending on fuel	158.54	179.32	170.34	159.51
	(242.11)	(351.46)	(285.59)	(244.43)
<i>N</i>	995	1003	997	980

mean coefficients; sd in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure A1: Main associations by treatment group, Berlin-Brandenburg agglomeration



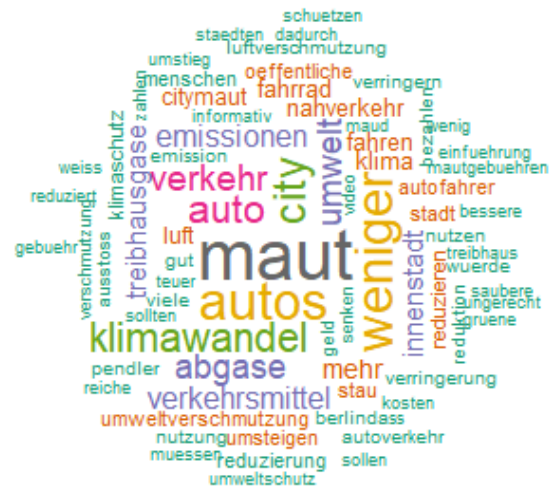
(a) Control



(b) Congestion



(c) Air pollution



(d) Greenhouse Gas emissions

Figure A2: Main associations by treatment group, Paris - Ile-de-France agglomeration



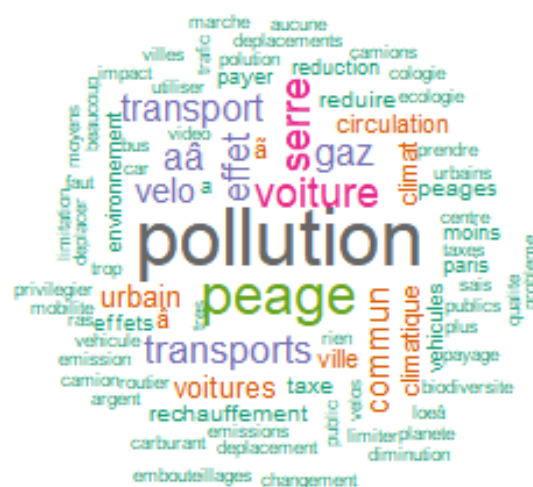
(a) Control



(b) Congestion



(c) Air pollution



(d) Greenhouse Gas emissions

urban toll. A reduced number of cars on the road reduces air pollution and is beneficial for everyone's health.

3. Environment/greenhouse gas (GHG) emissions: Motorised vehicles, such as cars, light-weight trucks or motorbikes are an important source of GHG emissions, contributing to global climate change. A solution to reduce driving and GHG emissions is to introduce an urban toll. A reduced number of cars on the road decreases GHG emissions and thus the climate impact of the transport sector.
4. Control: The German capital Berlin [French capital Paris] and the surrounding state of Brandenburg [cities of Île-de-France] together form the closely intertwined metropolitan region of Berlin-Brandenburg ["Métropole du Grand Paris"]. Berlin [Paris] is divided in 12 [20] administrative divisions. Each district is presided over by a mayor who resides in the mayor's office of her or his district.

A3 Questionnaire

Intro screen

This survey is conducted for academic research purposes by researchers from the Department of Economics at the Technical University of Berlin (TU) and the University of Applied Sciences in Bochum. The survey data is used for research purposes only, in a non-partisan way. Your name will never be recorded by the researchers. The published results may include summary data, but will not identify you. The data will be stored on TU servers and will remain confidential. Anonymized data may be made available to other researchers for replication.

Please note that it is very important for the reliability of the research that you answer honestly and read the questions carefully before responding. If at any time you do not know the answer to a question, please give your best estimate without consulting outside resources.

We hope you enjoy completing the questionnaire and thank you in advance for your cooperation.

We will start with some questions about your personal situation.

B1: What is your gender? [Male, Female, Non-binary, Prefer not to answer]

B2: What is your age? Please indicate your age in years: [], Prefer not to answer

B3: What is the highest level of education you have attained? [No formal education; Elementary school; High school; Bachelor's level; Vocational training; Bachelor's degree; Master's degree; Doctorate]

B4: What is the postal code of your main residence? [5 digits]; Prefer not to answer

B5: How many people live in your household, including yourself? Please distinguish between those who are 14 years or older and those who are younger. [1-19 allowed] Person(s) 14 years of age or older; 1-19 allowed] Children under the age of 14; Prefer not to answer]

B6: How many children do you have, whether or not they live in your household? Also include children who have, for example, moved away or are living with another parent. [Numerical; I have no children]

B7: Could you please indicate what range your total net monthly household income is? If you do not know exactly, please give your best estimate. [less than 500 EUR; 500-999 EUR; 1000-1499; 1500-1999; 2000-2499; 2500-2999; 3000-3499; 3500-3999; 4000-4499; 4500-4999; 5000-5499; 5500-5999; 6000-6499; 6500 or more; Prefer not to answer]

B9: [If B8 = "Employed full-time", "Employed part-time" or "Self-employed"] If you work in any of the following industries, please select the one that best describes your industry. [Taxi; Driver on a mobility platform (e.g. Uber); Public transportation; Automobile manufacturing; Medical/health; Oil, gas or coal; Other energy industries; Cement production; Construction; Iron and steel manufacturing; Chemical manufacturing; Plastics production; Pulp and paper production; Agriculture (crop or livestock); Air transportation (e.g. airlines); None of the above].

B10: How many hours do you work per week (approximately)? [numfeld]

B11: Does your job allow you to work from home? [yes/no]

B12: [If B11 = "yes"] How many days per week can you or do you choose to work from home? [numfeld: 1-6]

B13: Do you suffer from cardiovascular or respiratory disease? [yes/no]

B14: Does anyone else in your household have cardiovascular or respiratory disease? [yes/no]

P. Personal Attitudes [Intro text:] Now we would like to ask you some personal questions and opinions.

P1: In our society, there is often disagreement about the extent of personal freedom of choice that an individual should have. To what extent do you agree or disagree with each of the following statements? [strongly disagree, disagree, somewhat disagree, indifferent, somewhat agree, agree, strongly agree].

Rows: - The government interferes way too much in our daily lives.

- Sometimes the government has to make laws to prevent people from hurting each other.

- It's not the government's job to try to protect people from themselves.

- The government should stop telling people how to live their lives.

- Government should do more to advance society's goals, even if it means limiting people's freedom and choices.

- Government should place limits on the choices individuals can make so that they do not interfere with what is good for society.

P2: People in our society often disagree on issues of equality and discrimination. To what extent do you agree or disagree with each of these statements? Columns: [strongly disagree, disagree, somewhat disagree, indifferent, somewhat agree, agree, strongly agree].

Rows: - We have gone too far in promoting equal rights in this country.

- We would be a better society if the distribution of wealth were more equal.

- We need to dramatically reduce the inequalities between rich and poor, white and colored, male and female.

- Discrimination against minorities is still a very serious problem in our society.

- It seems that minority groups do not want equal rights, they want special rights just for them.

- Society as a whole has become too soft.

P3-P8: To what extent do you agree with the following statements? Columns: [strongly disagree, disagree, somewhat disagree, indifferent, somewhat agree, agree, strongly agree].

Rows: P3: Humans have the right to alter the natural environment to meet their needs.

P4: Humans are severely abusing the planet.

P5: Plants and animals have the same right to exist as humans.

P6: Nature is resilient enough to cope with the impacts of modern industrial nations.

P7: Humans are supposed to dominate the rest of nature.

P8: The balance of nature is very delicate and can be easily upset.

P9: How much confidence do you have in the French government to deal with the effects of climate change? [scale from 0 "not at all confident" to 10 "completely confident"; Prefer not to answer]

P9: How much confidence do you have in the French government to deal with the effects of climate change? [scale from 0 "not at all confident" to 10 "completely confident"; Prefer not to answer]

P10: How much do you personally trust each of the following institutions? [scale from 0 "not at all confident" to 10 "very confident" + Prefer not to answer] - the national parliament - the city council - the judicial system - the police - politicians - political parties - the European Parliament - the United Nations - scientists

P11: In general, how important do you think it is to stay informed about politics in your city or state? [scale from 0 "not at all important" to 10 "very important"]

P12: In politics, we often talk about "left" and "right" to describe different political views. When you think about your own political views, how would you rate them on the scale below? Please answer using the following scale: 0 means extreme left, 10 means extreme right. - scale from 0 "extreme left" to 10 "extreme right". - Prefer not to answer

P13: Do you think traffic congestion is a serious problem in your city or region? [yes/no]

P14: Do you think air pollution is a serious problem in your city or region? [yes/no]

P15: Do you think climate change is a serious problem? [yes/no]

P16: Who should primarily pay for urban transportation infrastructure? - All residents of Île-de-France. - Residents of central Paris - Motorists - High-income households

P17: Who should primarily pay for urban air quality? - All residents of Île-de-France. - Residents of central Paris - Motorists - High-income households

M. Mobility

M1.1: How many cars does your household own? [numfeld] M1.2: Of these, how many have an electric motor? [numfeld] M1.3: Of these, how many are company cars? [numfeld] M2: In a typical month, what is your fuel budget for your vehicles? If you do not know the exact answer, please provide an estimate. [numfeld] € M3: Has the increase in fuel prices in recent months had an impact on your travel habits? [yes/no] [if M3 = "Yes"] It is important for us to understand exactly how you have changed your behaviors. Everyone is different and we want to understand

your individual behavior as best we can.

Please describe below, as concretely as possible, the impact of higher fuel prices on your behavior and changes in your travel patterns. [open field]

M4: What mode of transportation do you primarily use when traveling for business purposes? - Car - Motorcycle - Public transportation - Bicycle or scooter - Walking - Other - Not applicable

M5: What mode of transportation do you primarily use when traveling for personal reasons? - Car - Motorcycle - Public transportation - Bicycle or scooter - Walking - Other - Not applicable

M6: During which time slots do you drive most frequently? Dropdown menu: - 4-5 h - 5-6 h - 6-7 h - 7-8 h - 8-9 h - 9-10 h - 10-11 h - 11-12 h - 12-13 h - 13-14 h - 14-15 h - 15-16 h - 16-17 h - 17-18 h - 18-19 h - 19-20 h - 20-21 h - 21-22 h - 22-4 h - None of the above

M7: Do you regularly go to downtown Paris, for work or other reasons? [yes/no] M8: How would you rate the availability (ease of access and frequency) of public transportation where you live? - Very poor - Poorly - Fair - Good - Excellent - Prefer not to answer

M9: How would you rate your personal safety when traveling by public transportation? - Very poor - Poorly - Fair - Good - Excellent - Prefer not to answer

M10: Have the protest movements in recent weeks or months had an impact on your mobility behavior? (SINGLE PUNCH) Yes No

C. City tolls

Randomly split the sample into four equally sized groups Randomization should be done at zip-code level

- Control, TEXT, VIDEO Control text: "We are now going to show you a 3-minute video (without audio track) that gives you some information about the administrative structure of your city. Please pay attention to the information provided as you will be asked questions about it later. Do not move to the next page or close the page while the video is playing. Please proceed to the next page when you are ready."

- Time savings, TEXT, VIDEO - Health, TEXT, VIDEO - Environment, TEXT, VIDEO

Treatment text: "Some cities around the world have introduced congestion charges. Congestion charges are daily charges that are levied if you drive a car in specific areas of a city. Recent academic research has studied the effects of congestion charges. We are now going to show you a 3-minute video (without audio track) that describes the operation and effects of a congestion charge. Please pay attention to the information provided as you will be asked questions about it afterwards. Do not proceed to the next page or close the page while the video is playing. Please proceed to the next page when you are ready."

C1: Were you able to watch the video to the end? - Yes - No, there was a technical problem - No, I skipped part of the video C1.1 Was the information presented in the video clearly understandable? - Yes, it was - Yes No

Text PARIS Please consider the introduction of a congestion charge in Paris. The toll is a daily charge of €7.5 that applies to all vehicles traveling in the area bounded by the "périphérique", shown below. The congestion charge applies from 7:00 a.m. to 6:00 p.m. Monday through Friday

and from 12:00 p.m. to 6:00 p.m. Saturday through Sunday and on public holidays.

C2: Do you support or oppose a congestion charge as described above? [strongly oppose; somewhat oppose; neither support nor oppose; somewhat support; strongly support]. prefer not to answer]

C3: Do you agree or disagree with the following statements? A congestion charge would... Columns: [for each statement: "strongly disagree"; "somewhat disagree"; "neither agree nor disagree"; "somewhat agree"; "strongly agree"]

Rows: - encourage people to drive less - reduce fossil fuel use and greenhouse gas emissions - reduce air pollution - increase traffic speed - reduce the number of accidents - Other: [open text]

C5: Do you think you would change your mobility behavior if such a toll were implemented? [yes/no] [C6: How do you think you would change your behavior? [multiple options possible] - Drive less - Drive during different time slots - Use public transport more - Ride a bike or walk more - Work from home more often - Other, please specify [open field].

C7: In your opinion, would the following groups lose or gain if a congestion charge was implemented in Paris:

Columns: [largely lose; somewhat lose; neither lose nor win; somewhat win; largely win]? Rows: - low-income people - middle class - high-income people - people living in urban areas - those living in suburban areas

C8: Do you think your household would gain or lose financially from a congestion charge? [largely lose; somewhat lose; neither lose nor gain; somewhat gain; largely gain] + prefer not to answer

C15: To show that you are paying attention, please select "somewhat" from the following list: [Not at all; Somewhat; Moderately; Very much; Very well].

Through payments by motorists, congestion pricing generates new revenue for local governments. There are different options for using the toll revenues.

C10: Can you think of other compensation mechanisms that you would consider appropriate to compensate residents of Île-de-France for their expenses related to congestion charges? [open field]

C11: Suppose the Paris City Council decides to spend the toll revenues as direct compensation to households residing throughout the Ile de France. Which option do you prefer? - All households in Île-de-France should receive the same amount of toll revenue. - Only low-income households in Île-de-France should receive the compensation. - Only "heavy users" in Île-de-France should receive the compensation. - Prefer not to answer

C12: Do you agree or disagree with the following statements? A congestion charge is unfair because : Columns: [strongly disagree, somewhat disagree, indifferent, somewhat agree, strongly agree].

Rows: - City residents receive too much political attention. - Suburban residents get too much political attention. - Too much public money is already being spent on cities. - Too much public money is already being spent on the suburbs.

C12.1: Do you agree with the following statement? [strongly disagree, somewhat disagree,

indifferent, somewhat agree, strongly agree] - Roads should be free for everyone.

C13: If there were an election in your city next Sunday, which party do you think would propose or support a congestion charge? [Several options possible] [La France Insoumise, Parti Socialiste, Europe Écologie Les Verts, Renaissance (ex-LREM), Les Républicains, Rassemblement National, Reconquête, Prefer not to say].

C14: In your opinion, should Paris residents pay a reduced rate under a congestion charge? [yes/no/prefer not to answer]

PRG: If C14 = "yes", PLEASE SHOW ON THE SAME SCREEN: There may be many reasons for a reduced rate for Paris residents. It is important for us to understand and take into account each individual opinion. Please describe below why you think Paris residents should receive a reduced rate under a congestion charge. (OPEN, 1 textfield)

PRG: If C14 = "no", PLEASE SHOW ON THE SAME SCREEN: There may be many reasons not to give a reduced rate to Paris residents. It is important for us to understand and take into account each individual opinion. Please describe below the reasons why you think Paris residents should not receive a reduced rate under a congestion charge. (OPEN, 1 textfield)

[If C14 = "yes"] C14.1: What should the percentage reduction be? [slider 1-100]

A Low Emission Zone is a defined area in a metropolitan area where access for certain polluting vehicles is restricted in order to improve air quality. In the Greater Paris Metropolis, only low-emission vehicles are allowed to enter the Low Emission Zone without restriction in order to reduce air pollution caused by diesel soot (fine particles) and nitrogen oxides. These vehicles must have a minimum Crit'Air 3 rating. However, vehicles with high emissions can be driven at night and on weekends. The Low Emission Zone of the Greater Paris Metropolis covers 79 municipalities located in all or part of the perimeter of the A86.

C16: Do you support or oppose a low emission zone as described above? [strongly oppose; somewhat oppose; neither support nor oppose; somewhat support; strongly support] Prefer not to answer

C17: Do you support or oppose the following traffic policies?

Columns: [strongly oppose; somewhat oppose; neither support nor oppose; somewhat support; strongly support]

Rows: - 30km/h speed limit in city centers - Higher registration tax for polluting cars - Stricter environmental standards for new cars - More bicycle lanes in cities - Better public transport - Higher parking fees

C18: Do you support or oppose the following environmental policies? Columns: [strongly oppose; somewhat oppose; neither support nor oppose; somewhat support; strongly support]

Rows: - A beef tax of €7/kg, a pork tax of €2/kg and a poultry tax of €1.50/kg - A national carbon tax of €100/ton, which increases the price of gasoline by 23 cents per liter. - A tax on airline tickets, which increases the price of tickets by 20- Subsidies for low-carbon technologies (renewable energy, carbon capture and storage...).

C19: Suppose the French government reforms the existing national carbon tax so that the

revenue from the tax is redistributed directly to citizens. Which option do you prefer?

- All households should receive the same amount of carbon tax revenue. - Only low-income households should receive the carbon tax revenue. - Only households with high energy needs should receive carbon tax revenues. - Prefer not to answer

F. Feedback F1: Do you think this survey was politically biased? [Yes, left-wing bias; Yes, right-wing bias; No, I don't feel like it was biased]

F2: The survey is almost complete. You can now enter your comments, thoughts or suggestions in the field below. [Open field]