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ARTICLE

Yes, we can! The effect of collective versus individual action framing on the acceptance of hard climate adaptation policy instruments

Valerie Dewaelheyns[1,2], Pieter Raymaekers[1], Florian Lange[3], Ben Somers[2] and Trui Steen[1]

[1]Public Governance Institute, KU Leuven, Leuven, Belgium; [2]Division Forest, Nature and Landscape, Department of Earth and Environmental Sciences, KU Leuven, Heverlee, Belgium and [3]Behavioral Economics and Engineering Group, Faculty of Economics and Business, KU Leuven, Leuven, Belgium
Corresponding author: Valerie Dewaelheyns; Email: valerie.dewaelheyns@kuleuven.be

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Abstract
Especially in the context of climate adaptation policy, creating support for hard policy instruments and convincing people that their individual contributions do matter are two significant challenges. In this study, we test the effect of an individually versus collectively framed gain-appeal infographic on the acceptance of hard policy instruments and this in the context of strictly private climate change adaptation behaviour. We used a mixed methods approach focussing on reducing private paving in domestic gardens in Belgium. Evidence from an online survey experiment ($n = 3{,}389$) showed that policy makers implementing a collectively framed infographic can increase the acceptance of a more strict permit policy and a yearly financial contribution, while simultaneously enhancing personal and collective self-efficacy and outcome expectancy beliefs. Complementary insights from qualitative data learned that perceived (in)equity is a crucial point of attention when designing climate policies addressing private paving. A collectively framed infographic may convey the message 'yes, we ánd I can'. With these "findings, we want to trigger new opportunities in climate policies beyond the current policy scopes.

Keywords: climate-friendly gardening; framing; individual versus collective; mixed method; policy support

Introduction

As climate change increasingly confronts us with more extreme weather events, the role of human behaviour in contributing to climate mitigation and adaptation gains significance (Nielsen *et al.*, 2024). To stimulate citizens towards individual behavioural changes, governments can use a range of policy interventions, yet citizens' support is crucial for the success of these interventions (Grelle and Hofmann, 2023). Evidence in the domain of health care indicates that citizens tend to show more support for

softer interventions such as communication and framing (Banerjee *et al.*, 2021), while harder policy instruments such as regulations and financial incentives are usually more effective (Verplanken and Wood, 2006).

Soft policy interventions can be applied independently or used to strengthen public support for hard policy instruments (Tummers, 2019; Capano and Howlett, 2020), for example on climate change mitigation (Ockwell *et al.*, 2009). Béland and Cox (2024) demonstrated how framing helped to turn the policy idea of 'sustainability' into a robust justification for policy proposals. Dabla-Norris and colleagues (2024) showed across 28 countries that information campaigns on the effectiveness of climate change mitigation policies increased support for those policies. The effect of such campaigns may critically depend on which information is selected and how this information is framed (Tversky and Kahneman, 1981). Framing, or highlighting certain aspects of a topic by using specific wording and imagery (Entman, 1993), can significantly influence how the public perceives and interprets the message (Chong and Druckman, 2007). Framing studies cover different domains, such as climate change (Badullovich *et al.*, 2020), health (Gallagher and Updegraff, 2012) and immigration (Avalos and Moussawi, 2023).

In the domain of private climate action, information-based interventions may benefit from highlighting individuals' contributions to climate change adaptation. Citizens tend to assign responsibility for dealing with climate change to companies and governments rather than to individuals and households (Unsworth *et al.*, 2016; Chater and Loewenstein, 2022). Here, efficacy messages that illustrate how citizens can contribute to climate change adaptation may be helpful in generating support for climate policies (Bolsen and Shapiro, 2018; Guenther *et al.*, 2023).

To date, we lack sufficient insights on the influence of different messages and message frames on climate change adaptation behaviour (Hornsey and Fielding, 2020). Only few studies tested the effectiveness of efficacy messages in general, and most studies focused on climate change mitigation (Badullovich *et al.*, 2020), largely disregarding adaptation. Moreover, it is still unclear if efficacy messages for policy support are more effective when stressing the potential contribution of the individual (individual framing) or of larger groups of citizens (collective framing) (Grelle *et al.*, 2024). Hence, the question how climate change messaging can effectively support hard climate adaptation policies remains particularly relevant.

In this study, we used a mixed method approach centred around an online survey experiment to study the effect of individual and collective framing of efficacy-focused information on the acceptance of hard climate policy instruments. In addition, we explored whether such framed information affected citizen's efficacy beliefs and delved into citizens' opinions regarding climate change adaptation policies in the private sphere. Before measuring their support for four hard policy instruments, we exposed participants to either no information (control group), collectively framed information, or individually framed information. The information was presented visually as an infographic. The effect of the framed information was estimated by comparing policy support scores across groups.

We demonstrated that the collectively framed information significantly increased the acceptance for a more stringent permit and the introduction of a financial contribution yet with small effect sizes. Moreover, the exploratory quantitative analysis

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indicated a positive spillover effect of both frames on efficacy beliefs, while the qualitative analysis highlighted the need for more than a framing intervention to ensure acceptance of hard policies (e.g. equity of policy and a conscious use of framing). This research contributes to behavioural public policy by suggesting how policymakers can frame government messages to increase support for necessary but often unwanted hard policy measures.

The case of reducing private paving in Flanders (Belgium)

We answered our research question by focussing on the reduction of private paving in domestic gardens in Flanders, the northern region of Belgium. Domestic gardens are private areas adjacent to residential buildings where residents hold autonomy over garden design and management (Cameron *et al.*, 2012). Private paving is the permanent covering of garden soil by completely or partly impermeable artificial material (European Commission, 2011), for example by bricks, tiles, or pebbles, for different functions such as pathway, driveway, car parking, and terrace.

Especially in urban areas, reducing the paved area is a significant climate adaptation action. Paving increases climate vulnerability by reinforcing heat, drought, and flooding (Artmann, 2014; Heikoop, 2022). As up to one-third of Western-European urban areas is covered by domestic gardens that are increasingly being paved by citizens (Artmann, 2014), policymakers should consider individual garden paving choices in their climate policies.

Effectively dealing with private paving can be achieved through various policy instruments with different degrees of authoritative force (e.g. sticks, carrots and sermons): top-down regulations including the prescription of paving limits as well as control and enforcement; and economic interventions such as taxes and incentives (European Commission, 2011; Strohbach *et al.*, 2019; De Wilde *et al.*, 2023). Yet, little is known about how policymakers can create and strengthen public acceptance for these hard policy instruments targeting private gardens. Therefore, we will focus on testing whether collectively and individually framed information impact the support for each of these instruments.

Flanders makes an interesting case. Domestic gardens cover over 12% of the Flemish area (Wittemans *et al.*, 2024); and of this total Flemish garden area up to 21% is paved (Digitaal Vlaanderen, 2021). Moreover, the strictly private character of these gardens gives citizens the sense that the government should not intervene in these private spaces. Combined with the lack of contemporary garden related policies, this leaves policy makers with little motivation for policy intervention (Dewaelheyns *et al.*, 2016). Finally, citizens' support of hard climate policy interventions targeting domestic gardens is still poorly understood.

Theory

Framing as message design

Information-based interventions are considered helpful in strengthening public support for hard policy instruments, which are essential in slowing down and ultimately stopping the current increase in private paving (Strohbach *et al.*, 2019). The success

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of such interventions likely depends on the framing of information. By highlighting certain elements of an issue and leaving out other aspects, framing can provide both the analysis and solution of a problem in a condensed and accessible way. Moreover, by focussing on specific aspects, framing can make a message more personal relevant and understandable, while remaining true to the underlying science (Entman, 1993; Nisbet, 2009; Hall *et al.*, 2016). Consequently, it can influence how the public perceives the message and, for example, change the public's perception of the importance of a policy intervention (Druckman, 2001; Chong and Druckman, 2007). Since it ensures freedom of choice, framing can be considered a 'nudge' (Thaler and Sunstein, 2008; Hall *et al.*, 2016), or vice versa nudging can also be considered a way of framing choices (John *et al.*, 2009). Hall (2016) considers both framing and nudging as tools to design the decision-context.

The question is how to frame a message in such a way that it effectively increases citizens' support for hard climate policy instruments. Various climate frames have been presented, such as 'public health', 'harmful impacts' or 'morality and ethics' (Nisbet, 2009; Bolsen and Shapiro, 2018; Badullovich *et al.*, 2020; Guenther *et al.*, 2023), with evidence for mixed effects (Hart and Nisbet, 2012; Bolsen and Shapiro, 2018; Palm *et al.*, 2020). In the context of private paving or other private sphere climate-relevant domain (e.g., water conservation in China (Li and Wang, 2024) or food choices in Sweden (Bendz *et al.*, 2023), it seems particularly promising to stress how individuals can contribute to large-scale climate relevant impact (Bolsen and Shapiro, 2018; Guenther *et al.*, 2023). Such efficacy-focused information can come in different shapes and forms.

Individual and collective self-efficacy and outcome expectancy

Dealing with climate change requires the collective impact of numerous individual contributions, even if those actions are very small (Rosentrater *et al.*, 2013). As such, frames generating a sense of positive self-efficacy, being one's beliefs in the own capabilities to perform a specific behaviour, are found to spur engagement and support for climate change action (Bolsen and Shapiro, 2018). Outcome expectancy may be even more important, as it refers to one's beliefs about the likely outcome or efficacy of one's action (Koletsou and Mancy, 2011). Public support for policies is sensitive to evidence of their (in)effectiveness. If people believe that a policy measure will lead to the desired outcome, their public support for this measure will likely be higher (Reynolds *et al.*, 2020; Grelle and Hofmann, 2023; Koenig *et al.*, 2024).

Efficacy-focused beliefs can relate to a collective goal (e.g. climate change adaptation) and can be divided into two levels of action, being the individual and the collective level (Koletsou and Mancy, 2011). For example, some people may believe that the design of their individual garden can contribute to climate change adaptation while others believe that only the collective impact of many garden owners can make a difference. An open empirical question is then whether climate adaptation information and behaviours should be framed individually or collectively to be most effective.

In the context of private paving, citizens generally lack a profound understanding of both the individual and collective impact of paving decisions (Dewaelheyns *et al.*, 2016). Depaving efforts are mostly individual in terms of time, money and giving up

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expectations, likely leading to a low personal self-efficacy. Since gardeners can only make relatively small individual contributions to deal with climate change, their personal outcome expectancy may be (very) low as well. The cumulation of individual actions may achieve the collective outcome of climate adaptation, but individuals may not be aware of that (i.e., they may lack collective outcome expectancy). Similarly, their collective self-efficacy may be low (e.g. due to lack of trust in the contributions of others (Gifford, 2011).

Informing citizens that the removal and prevention of paving are effective actions with positive consequences (e.g. reduced flooding and cooling during heat waves) may increase citizens' outcome expectancy and consequently their support of depaving policies. Persuasive climate change communication might even be more effective when using a collective action frame highlighting the cumulative benefits of collective efforts, rather than focussing on the individual advantages of personal efforts. Cumulative outcomes are inherently larger than the individual ones while benefiting both the individual and society. Also, Cornwell and Krantz (2014) found higher support for policies when their justification was framed in the third-person using 'people' rather than using the second-person 'you'. Based on these considerations, we developed the following hypotheses about the effect of framed efficacy messaged to be tested in our empirical study.

Preregistered hypotheses

We preregistered three main hypotheses. The first two hypotheses state that communicating efficacy information about the effective benefits of depaving leads to a higher support for hard policy instruments compared to no communication. We expect that this is the case for both individually framed information (*Hypothesis 1*), and collectively framed information (*Hypothesis 2*). To test these hypotheses, the mean support of hard policy in the control group was compared to the mean support of each group that received framed information (individually and collectively). Our third hypothesis posits that the collectively framed information leads to a higher support for hard policy instruments compared to the individually framed information (*Hypothesis 3*). This hypothesis was tested by comparing the mean support of hard policy between the two groups that received framed information.

Each of the three main hypotheses is applied to individuals' support for four different policy-instruments (dependent variables): (a) a more stringent permit policy (*Hypothesis 1a, 2a and 3a*); (b) a more stringent enforcement policy (*Hypothesis 1b, 2b and 3b*); (c) the introduction of a yearly financial contribution determined by the share of paving in the garden (*Hypothesis 1c, 2c and 3c*), and (d) the introduction of a subsidy for private depaving (*Hypothesis 1d, 2d and 3d*). This results into 12 preregistered hypotheses in total (Supplementary Table 1). We preregistered that the main hypothesis would be considered confirmed when all tests corresponding to the four related sub-hypotheses reveal statistically significant differences. If at least one sub-hypothesis is confirmed, we consider the results to provide partial support for the main hypothesis.

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Methods

Experimental design

Centred around an online survey experiment, we applied a mixed methods approach. While the survey experiment allows for an internally valid estimation and comparison of the effectiveness of the frames, the accompanying qualitative data from an open-ended text response box provide a more profound understanding of participants' opinions on the framed infographics as well as their ideas on paving policies targeting private gardens.

The survey experiment was designed as a 'posttest-only control-group design' with three groups, comparing two intervention groups (individually framed information and collectively framed information) and one no-message control group (Blom-Hansen *et al.*, 2015). We randomly assigned individuals to the three groups. The quality of the random assignment was assessed using balance tests on six preregistered control variables: age, gender, statute (owner/renter/other), housing type, housing environment and garden (yes/no). Participants' age is measured based on their year of birth.

Data collection

The study was conducted in Flanders, the northern Dutch speaking region of Belgium. The survey was launched in Qualtrics on 20 October 2023 and ended on 20 November 2023. Recruitment took place online involving a convenience sample. Participants were recruited in several ways: through the voluntary subject-pool of the citizen science platform on garden research MijnTuinlab (www.mijntuinlab.be); through mailings to professional and personal networks; through digital newsletters of associated organisations; via social media posts; and via snowball sampling. Participants provided their informed consent before starting the survey and no compensation for participation was offered.

Based upon a systematic review by O'Keefe and Hoeken (2021), we considered an effect of $r = 0.15$ (equals Cohen's $d = 0.303$) the smallest effect size to be of interest, so we designed the study to be sensitive enough to detect it. Our preregistered goal was to obtain 0.80 power to detect a small effect size of Cohen's $d = 0.303$ at the standard 0.05 alpha error probability. With a 20 per cent buffer, we preregistered to recruit at least 490 participants, a number based upon an a priori power analysis using G*Power (Faul *et al.*, 2007; Erdfelder *et al.*, 2009). We preregistered to stop data collection as soon as we noticed that the number of complete responses exceeded the target sample size. We did not put a quota on the responses beforehand because we did not expect to easily reach the targeted sample size.

Due to a sudden fivefold increase in a short period of time on the date of 24 October 2023, from 150 to over 800 participants, we opted to deviate from our preregistered target sample size. Instead, we decided to collect data for a fixed arbitrary period of one month. Reasons were twofold: recruitment communication was just sent out; and more data increases the power of the study. We did not check the data at $n = 490$, nor did we analyse the data before we decided to stop the data collection. Finally, we

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collected data of in total $n = 4{,}313$ participants who started the survey experiment. For the confirmatory analysis, $n = 3{,}389$ participants were included in the analysis.

The protocol of this study was approved by the Social and Societal Ethics Committee (SMEC) of KU Leuven (SMEC file number: G-2022-5077-R3(AMD)). The experiment was preregistered at Open Science Framework on 19 October 2023 (https://doi.org/10.17605/OSF.IO/EV8YP). The data are published at the KU Leuven Research Data Repository and made openly available under de CC-BY-4.0 license (https://doi.org/10.48804/C2JTKS).

Experimental material

We used a single-frame design with emphasis information frames. Such frames direct individuals' attention to an emphasized subset of potentially relevant considerations, influencing individuals to focus (more) on these aspects (Bolsen and Shapiro, 2018; Guenther *et al.*, 2023).

Our interventions are framed infographics, combining text-based stimuli with a visual approach. They could be used by policy actors, and we designated the local government as a potential sender. We first developed a basic infographic, which was then framed from a collective and an individual action perspective (Figure 1). To ensure uniformity in visual appearance, the same visual elements were used across the frames, with the same number of text lines and consistent positioning of both visual and text-based elements. Both infographics were made with the free version and icons of Canva (www.canva.com). Figure 1 shows a representation, the original infographics are available from the corresponding author upon request. Before fielding, both infographics were pretested several times for their readability and clarity, and for a consequent use of framing devices, by an academic expert in framing and nine researchers not involved in the study.

For the infographic development, we build upon the findings by Lorenzoni and colleagues (2007) who identified the lack of knowledge; the perception of climate change as a distant threat; the externalization of responsibility; and helplessness as barriers to individual engagement in climate action. Therefore, we combined a positive gain appeal with objective information on climate change and the concrete outcomes of a specific adaptation action, while addressing everyday concerns at the personal and local level (Chong and Druckman, 2007; Scannell and Gifford, 2013; Whitmarsh *et al.*, 2019; Toomey, 2023).

The basic infographic contains the following elements: (a) slogan; (b) explanation; (c) facts and figures on the climate impact of garden paving; (d) call for action focusing on the outcome of depaving; and (e) benefits of less paving. Its main message is that less paving in gardens can make a positive difference, which is incorporated in the slogan, explanation, and call to action. With the metaphor 'oasis', we implicitly and positively connect the garden with climate change adaptation. The infographic espouses this main message by presenting scientific facts and figures on paving in gardens and its impact on heat, drought, and flooding, all climate-related phenomena that have been increasingly experienced by Flemish citizens over the past years. By communicating about these specific consequences and not about 'climate' or 'climate change', the infographic holds both a personal and local scale (van der Linden, 2015) that may reduce

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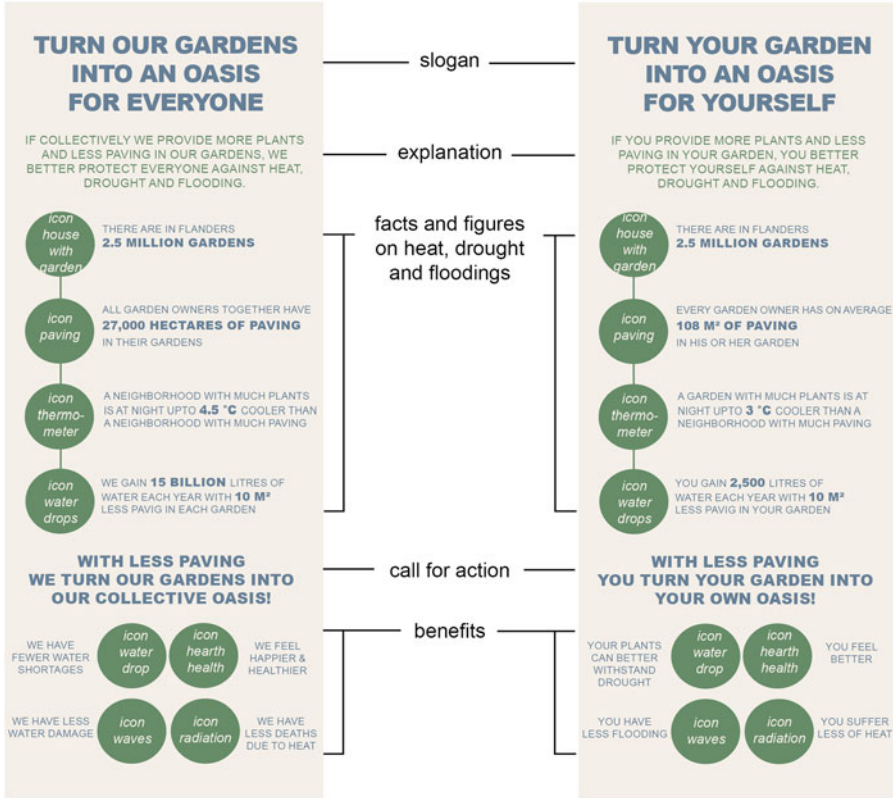

Figure 1. Representation of the infographics, with the collective frame (left) and individual frame (right) (translated from Dutch). The original infographics were made using the free version and icons of Canva and are available from the corresponding author upon request.

the psychological distance (Vlasceanu *et al.*, 2024) and evoke less resistance with climate sceptics. To incorporate the outcome of actual depaving behaviour, we included the effectiveness of removing 10 m^2 paving per garden on water infiltration.

Next, we created two versions of our basic infographic, each with a different frame representing a collective action and an individual action perspective (Figure 1). To achieve this, the main framing devices were wordings and numbers. We varied the wording of finite form (we, ours, everyone versus you, yours, yourself), textual elements (neighbourhood, communal, together, each versus garden, own, average), and benefits (societal versus personal perspective). By using the first-person plural pronoun 'we', we combine the insights of previous studies on a higher support for policies when using the third-person plural pronoun 'people' (Cornwell and Krantz, 2014) and a lower willingness to accept nudges using the third-person plural pronoun 'they' (Grelle *et al.*, 2024), both compared to the second-person singular pronoun 'you'.

The numbers gave the same information about the same facts but presented at the level of an individual garden (average numbers, comparison between individual

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gardens) in the individually framed infographic, and cumulated (total numbers, comparison between neighbourhoods) in the collectively framed infographic. Hence, the individually framed infographic emphasized individual numbers and personal benefits, whereas the collectively framed infographic highlights cumulative figures and the broader benefits for society.

Procedure and measures

After providing their informed consent, participants were randomly assigned to the groups (Figure 2). We used block randomization provided by Qualtrics survey software, ensuring that all three conditions were presented with equal frequency.

Intervention: Participants allocated to the control group received no information and passed on directly to the post-test measures section. Participants allocated to a group receiving an infographic were asked to carefully read the presented infographic, informing them that there would be questions about it later.

Right after showing the intervention, we included the attention check 'Which of the following elements was not present in the infographic?' with four response options (one correct answer). Time spent on the infographic page was also measured using the timing question in Qualtrics. Overall, participants spent on average $M = 68.53$ s on reading the infographic, but with a $SD = 369.33$ s. There was no evidence for differences in time spent between both frames ($M_{\text{collective}} = 69.35$ s, $SD_{\text{collective}} = 450.26$ s; $M_{\text{individual}} = 67.77$ s, $SD_{\text{individual}} = 272.74$ s; $W = 532260$, $p = 0.808$).

After the attention check, we asked participants to evaluate ten statements on the infographic and its use by their local government (5-point Likert scale totally disagree – totally agree) (Supplementary Table 2).

Post-test measures: The first post-test measure was our dependent variable. We asked participants to indicate to what extent they support or oppose (5-point Likert scale; totally against – totally for) four policy measures aiming at the prevention or removal of paving. Our instrument selection complements a study commissioned by the Flemish Government (De Wilde *et al.*, 2023) with expert consultations via personal communication. We included two regulatory and two financial instruments, balancing two existing instruments that would become more stringent with two new instruments that would be introduced.

Next, we asked participants to assess a selection of other measures for explorative analyses. To operationalize efficacy beliefs, we adapted the framework by Koletsou and Mancy (2011) into four Likert-scale items (agree or disagree, 5-point scale) for both the personal and collective level: personal efficacy, personal outcome expectations, collective efficacy, and collective outcome expectations (Supplementary Table 3). All items referred to the specific action of removing 10 m^2 of paving in the garden, which is also mentioned in the infographic. To determine who can indeed reduce 10 m^2 of sealed surface, we first asked participants if they have less than 10 m^2 paved area in the garden.

We also included one Likert-item on desire for policy on paving in gardens (5-point Likert scale, not – very much) (Grelle and Hofmann, 2023); a three item measure of climate change belief (Heath and Gifford, 2006; Lange and Dewitte, 2023) (5-point Likert-scale, totally disagree-totally agree); trust of participants in different governments, companies, scientists, citizens, other gardeners, and themself in dealing with the

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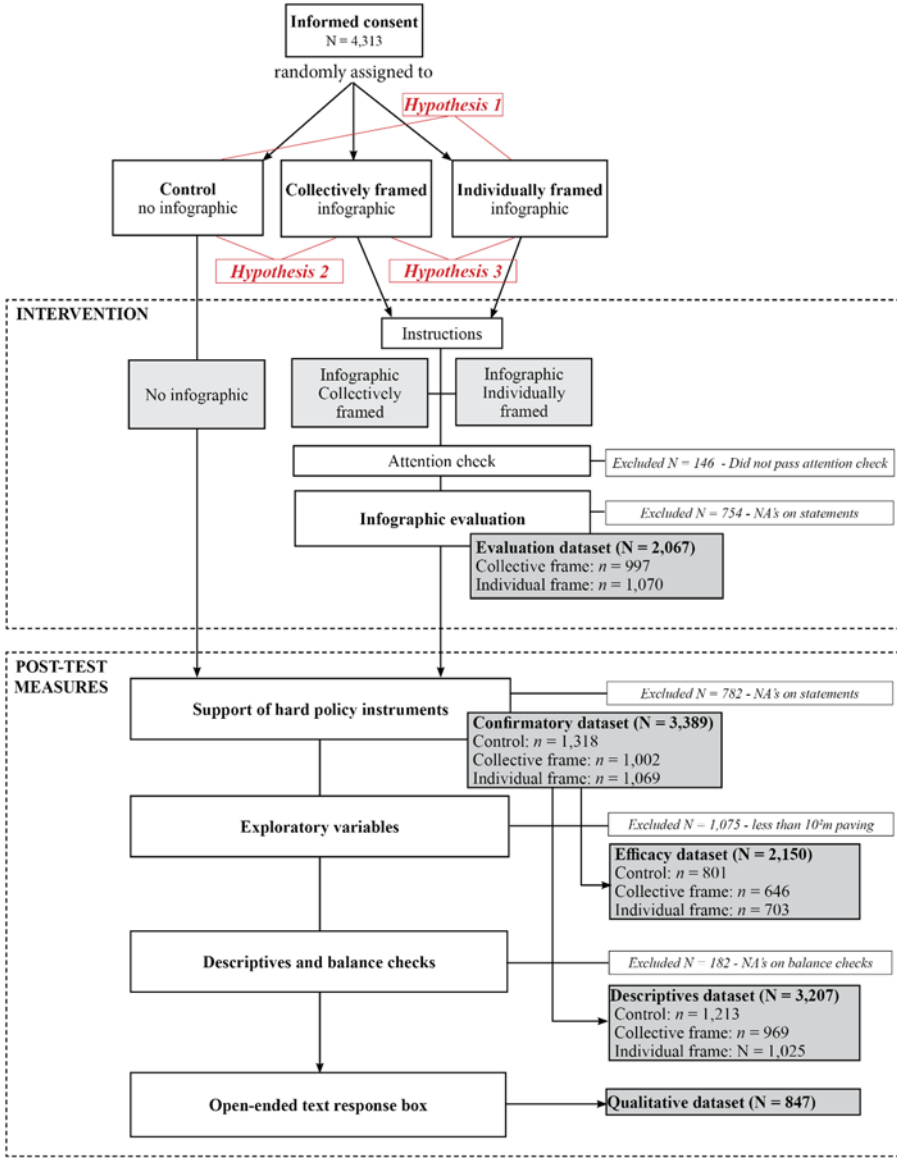

Figure 2. Outline of the survey flow and participants' selection. Depending on their randomly assigned group, respondents followed a different survey flow. From the $n = 4{,}313$ participants who started the survey, we composed five subsets for different analyses: confirmatory, descriptive (incl. exploration), efficacy, evaluation, and qualitative.

consequences of climate change (5-point Likert scale, very little-very much) (Rhodes *et al.*, 2017; Kitt *et al.*, 2021); and egoistic, altruistic, biospheric, and hedonic value orientations (Schwartz, 1992) (Supplementary Table 4).

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Finally, we asked personal and contextual information for sample descriptives and balance checks: gender, age, statute, housing type, housing environment and garden. Total duration of participation was recorded by Qualtrics, to allow identification of participants who rushed through the questionnaire. This variable was not pre-registered. As expected, we found significant differences between the control group ($M = 1{,}781.2$ s, $SD = 14{,}700.08$ s) and both intervention groups (collective: $M = 1{,}745.76$ s, $SD = 10{,}045.80$ s, W = 483334, p = 0.000; individual: $M = 2{,}072.26$ s, $SD = 19{,}626.04$ s, W = 505595, p = 0.000), but not between the two intervention groups ($W = 523714$, p = 0.383).

At the end of the survey, participants were offered the possibility to leave comments, suggestions and/or remarks in an open-ended text response box without limitations. As in the study of Savani and Collignon (2024), these responses provided us with qualitative data that made it possible to better understand participants' views and feelings regarding climate adaptation policies in the private sphere.

Analysis

Quantitative data analyses were performed in the R environment 2022.12.0 + 353 (R Development Core Team, 2005). For all statistical analyses, the significance level was set at $\alpha = 0.05$. Visual tests (QQ-plots, histograms, boxplots) and Shapiro-Wilks tests indicated that the data were not normally distributed, leading us to non-parametric methods.

For the descriptive and exploratory analysis, we used the non-parametric two-sided Wilcoxon Rank Sum t-tests to test group differences in continuous measures. Balance checks were performed using ANOVA for age (continuous data); Chi^2 test for gender, garden, and housing type; and due to small cell sizes Chi^2 test with simulated p-value for statute and housing environment (nominal data). The Chi^2 post-hoc testing was performed using the Bonferroni correction for multiple comparisons ('chisq.posthoc.test' package).

Each of the 12 sub-hypotheses was tested separately. Since the data were discrete, we used non-parametric one-sided Wilcoxon Rank Sum t-tests to examine potential treatment effects. Effect size was measured using Cohen's d (package 'effsize').

For the exploratory analysis of the framing effect on personal/collective self-efficacy and outcome expectancy, we included solely homeowners with a garden who indicated to have more than 10 m^2 paving in their garden. Tenants are often not allowed to make changes in the garden, and the statements were structured around (the impact of) removing 10 m^2 paving in the garden.

For exploratory correlation analyses, we used Spearman Rho correlation r_s coefficient for continuous measures. In case of more than two groups, we applied the Kruskal–Wallis test, followed by Dunn's tests with Bonferroni correction for p-values for multiple testing (if relevant). Associations between nominal measures were tested using the Chi-square test.

Qualitative data were analysed using NVivo 14 1.6.1. We used the inductive grounded theory approach (Strauss and Corbin, 1998) and applied manual open, axial, and selective coding on the anonymous open-text responses of $n = 847$ participants. We analysed the qualitative data separately from the quantitative. The actual coding was

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performed by one coder. After familiarizing with the data, initial codes were generated by subsequently breaking down the open-text responses in discrete pieces of information (open coding). In some cases, such pieces of information were assigned to multiple codes. These resulting codes were then aggregated and re-assembled into more distinct themes or categories by identifying overlap, links, and crosscuts (axial coding). Both coding phases were performed iteratively on the full dataset. The coding work by the principal researcher was compared to an independent summary made by a fellow researcher who screened the data. This allowed to notice possible bias as a result from coding by one single researcher (Koro-Ljungberg, 2008). Finally, the refined categories were synthesized and integrated into a theoretical scheme visualising interrelations between the main components (selective coding).

Participants

A total of $n = 4{,}313$ participants gave their informed consent and started the survey experiment. To ensure a sufficient sample size, we preregistered to not exclude people who fail the attention check. Since the actual sample size largely exceeded the required sample size, we decided to deviate from this preregistered intention and excluded $n = 142$ participants that didn't pass the manipulation check to increase data quality. Most of the participants (96 per cent) did pass the attention check question. In total, we derived five datasets, each including those participants who completed the necessary questions for each analysis (Figure 2).

Given the large variation coefficients for duration to complete the survey, we conducted a non-registered robustness check on the confirmatory analyses. Using arbitrary cut-off points, we removed participants who either rushed through the survey, or who took an excessive amount of time. In a lenient scenario, we used the 5^{th} and 95^{th} percentile as cut-off points (being 284.00 and 2,348.80 s), while in a strict scenario, we used the 10^{th} and 90^{th} percentile (being 34,400 and 1,463.20 s).

Results

Descriptives

Sample descriptives (descriptives dataset, $n = 3{,}207$). The descriptives dataset, containing participants who answered all required questions for the descriptive analysis, was largely representative for the general Flemish population regarding gender and age (older than 18 years) (Table 1). As expected, home ownership, suburban houses, and detached housing are overrepresented compared to the Flemish population since mainly home-owners with a garden, mostly residing in suburban areas, should have been motivated to participate in our survey experiment. Balance checks for both the descriptives and efficacy datasets indicated that sociodemographic characteristics were similarly distributed in the three experimental groups (Supplementary Table 5). Results of an explorative correlation analysis ($n = 3{,}207$) are provided in Supplementary table 7.

Support for hard policy instruments targeting private paving (confirmatory dataset, $n = 3{,}389$). In general, the introduction of a financial contribution on private paving raises the strongest opposition (45 per cent, totally oppose and oppose),

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Table 1. Socio-demographic characterisation of the participants (descriptives dataset $n = 3{,}207$). the percentage breakdown of several socio-demographic categories of the participants are compared to the Flemish population in general

	N	%	Flemish population	Reference
Gender				(Statbel, 2023b)
Men	1,606	50.08	49.50%	
Women	1,553	48.43	50.52%	
Unidentified	48	1.50	/	
Age (years)				(Statbel, 2023b)
0–17 year	2	0.06	/	
18–64 years	2,401	74.87	73.80%	
65+	804	25.07	26.20%	
Statute				(Policy Support Center Housing and Statistics Flanders, 2024)
Owner	3,021	94.20	72%	
Tenant	141	4.40	26%	
Resident	30	0.94	2%	
Other	15	0.47	/	
Urban typology				(Pisman *et al.*, 2018)
Urban	536	16.71	30%	
Suburban	1,454	45.34	22%	
Rural	1,205	37.57	48%	
No idea	12	0.37		
Housing type				(Statbel, 2023a)
Detached	1,613	50.30	39.21%	
Semi-detached	865	26.97	26.20%	
Terraced	624	19.46	28.30	
Apartment	105	3.27	6.30%	
	M	***SD***	**Flemish gardens**	
Garden cover shares				(Digitaal Vlaanderen, 2021; Somers *et al.*, 2021)
Sealed surface	18.23	13.70	31.29%	
Unsealed surface	78.93	14.30	63.39%	
Water	2.84	5.46	0.05%	

while the introduction of a subsidy for depaving receives the highest acceptance (74 per cent, accept and totally accept) (Table 2). The majority accepts a more stringent

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Table 2. Percentages of policy support and opposition for each of the four instruments ($n = 3{,}389$)

	Totally oppose (%)	Oppose (%)	Neither oppose nor support (%)	Support (%)	Totally support (%)
Stricter permit	6	12	12	36	34
Stricter control and enforcement	7	13	12	36	32
Introduction of financial contribution	24	27	18	19	12
Introduction of depaving subsidy	5	8	13	40	34

permit policy (70 per cent, totally accept and accept) and control and enforcement policy (68 per cent, totally accept and accept).

We added a non-registered aggregated measure of policy support for exploratory reasons. This 'hard policy support index' was calculated by taking the mean support score across the four instruments, serving as an indicator for general support of hard policy measures on private paving. Examining this index of support for hard policy, we find a mean support score of $M = 3.55$ ($SD = 0.88$).

Confirmatory analyses

The effect of framing on policy support (confirmatory dataset, $n = 3{,}389$). Mean support scores per group are presented in Figure 3 ($n_{\text{control}} = 1{,}308$, $n_{\text{collective}} = 1{,}002$, $n_{\text{individual}} = 1{,}069$).

We found evidence that the mean support score for a more stringent permit was higher in the group that received the collective frame compared to the control group [Cohen's $d = 0.082$ (−0.00, 0.16), $p = 0.039$], and that this is also the case for the introduction of a financial contribution [Cohen's $d = 0.115$ (0.03, 0.20), $p = 0.002$] (H2 partially accepted). We also found evidence that support for stronger permit conditions was higher in the group who received the collective frame compared to the group who saw the individually framed infographic [Cohen's $d = 0.101$ (0.01, 0.19), $p = 0.028$] (H3 partially accepted). All three effects were small.

We found no evidence for a difference in support between the group that received no information and the group that received the individual frame, and this for all four instruments (H1 not accepted) (Table 3). There was also no evidence for differences in support for a more stringent control and enforcement policy and a subsidy between the control group and the group that received the collectively framed information. When comparing both intervention groups, there was no difference in support for a stringent control and enforcement policy, nor for the introduction of a financial contribution or a subsidy for private depaving.

Our non-registered robustness analyses confirmed these results, using a lenient scenario ($n_{\text{control}} = 1{,}126$; $n_{\text{coll}} = 930$; $n_{\text{ind}} = 992$) and strict ($n_{\text{control}} = 971$; $n_{\text{coll}} = 847$; $n_{\text{ind}} = 892$) scenario on total duration of survey participation. In those robustness analyses, we also observed a small effect of the individual framing compared to the

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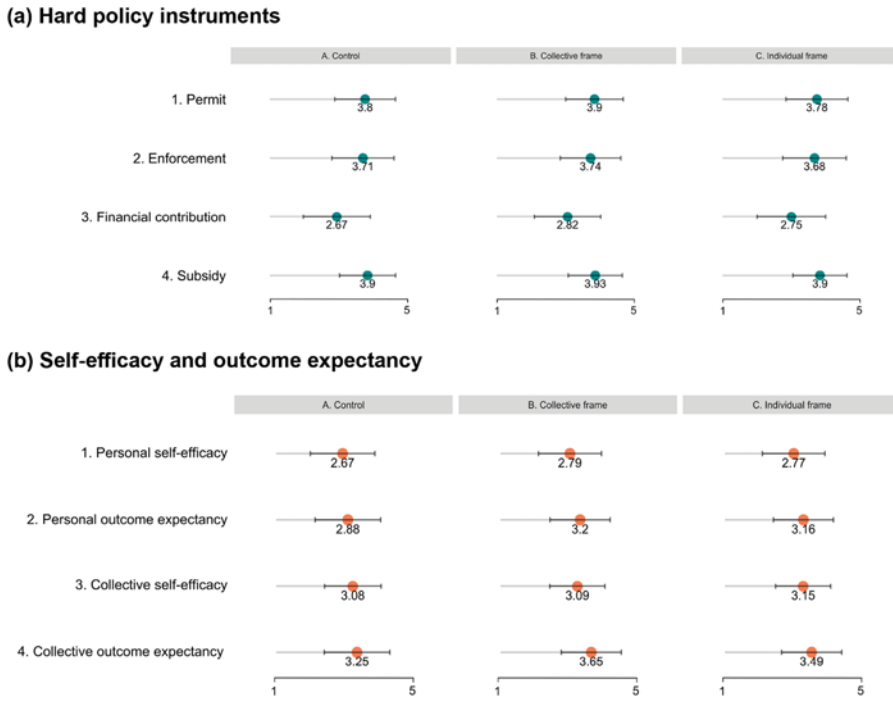

Figure 3. Mean scores and error bars (SD) of (1) support for the four policy instruments (top, $n = 3{,}389$) and of (2) self-efficacy and outcome expectancy statements (bottom, $n = 2{,}150$). These are presented for the different treatment groups. For the policy instruments: control group ($n = 1{,}308$), collective frame ($n = 1{,}002$), individually framed infographic ($n = 1{,}069$). For the self-efficacy and outcome expectancy statements: control group ($n = 801$), collectively framed infographic ($n = 646$), individually framed infographic ($n = 703$).

control group for the introduction of a financial contribution [lenient scenario: Cohen's $d = 0.089$ (0.00, 0.17), p = 0.02; strict scenario: Cohen's $d = 0.102$ (0.01, 0.19), p = 0.014] (Supplementary table 6).

Exploratory analyses

The effect of framing on hard policy support index (confirmatory dataset, $n = 3{,}389$). The data provide evidence for a small framing effect of the collectively framed infographic ($M = 3.59$, $SD = 0.84$) compared to the control group ($M = 3.52$, $SD = 0.90$) [Cohen's $d = 0.088$ (0.01, 0.17), p = 0.044] on the hard policy support index (Table 4).

The effect of framing on efficacy (efficacy dataset, $n = 2{,}150$). Mean self-efficacy and outcome expectancy scores per group are given in Figure 3 ($n_{\text{control}} = 801$, $n_{\text{collective}} = 646$, $n_{\text{individual}} = 703$). In the exploratory analysis we tested the effect of our frames on the personal as well as collective self-efficacy and outcome expectancy (Table 4). We found evidence that both the collectively [Cohen's $d = 0.095$ (−0.01, 0.20), p = 0.024] and individually [Cohen's $d = 0.084$ (−0.02, 0.18), p = 0.033] framed

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Table 3. Results of the confirmatory analysis

Confirmatory analysis (n = 3,389)	*W*	*p*	Cohen's d [CI]
Hypothesis 1 Individually framed information leads to a higher efficacy compared to no information			
1a – more stringent permit policy	708754	.606	−0.019 [−0.10, 0.06]
1b – more stringent control and enforcement policy	712112	.683	−0.026 [−0.11, 0.05]
1c – introducing a financial contribution	679459	.063	0.065 [−0.02, 0.15]
1d – introducing a subsidy for private depaving	711611	.674	0.002 [−0.08, 0.08]
Hypothesis 2 Collectively framed information leads to a higher efficacy compared to no information			
2a – more stringent permit policy*	633492	.039	0.082 [−0.00, 0.16]
2b – more stringent control and enforcement policy	655107	.367	0.022 [−0.06, 0.10]
2c – introducing a financial contribution*	616242	.002	0.115 [0.03, 0.20]
2d – introducing a subsidy for private depaving	654464	.349	−0.029 [−0.05, 0.11]
Hypothesis 3 Collectively framed information leads to a higher efficacy compared to an individually framed information			
3a – more stringent permit policy*	510800	.028	0.101 [0.01, 0.19]
3b – more stringent control and enforcement policy	525416	.219	0.048 [−0.04, 0.13]
3c – introducing a financial contribution	519455	.113	0.049 [−0.04, 0.13]
3d – introducing a subsidy for private depaving	525193	.210	0.028 [−0.06, 0.11]

Confirmed hypotheses are marked in bold and indicated with an * ($p < 0.05$).

infographic positively affected personal self-efficacy compared to the control group. Those effects were small.

There was evidence for a higher score for personal outcome expectancy of the collectively [Cohen's $d = 0.248$ (0.14, 0.35), $p < 0.001$] and individually framed group [Cohen's $d = 0.221$ (0.12, 0.32), $p < 0.001$] compared to the control group. Similar evidence was found for a higher collective outcome expectancy in the collectively [Cohen's $d = 0.387$ (0.28, 0.49), $p < 0.001$] and individually framed group [Cohen's $d = 0.222$ (0.12, 0.32), $p < 0.001$] compared to the control group. There was also evidence for a higher collective outcome expectancy score in the collectively framed group, compared to the individually framed group, with a small effect size [Cohen's $d = 0.166$ (0.06, 0.27), $p = 0.002$]. There was no evidence for an effect on collective self-efficacy (H1, 2&3 partially accepted). Overall, effect sizes are small, but higher for the collectively framed infographic compared to the individually framed infographic.

Evaluation of the infographics (evaluation dataset, n_{total} = 2,067). We analysed the participants' evaluation of the infographics to look for potential reasons for differences in effects between the individually and collectively framed information. Our quantitative evaluation dataset ($n_{\text{collective}} = 997$; $n_{\text{individual}} = 1{,}070$) included participants who answered all required questions for the confirmatory analysis.

We found evidence that the collectively framed infographic scored higher on surprising information [$W = 558923$, $p = 0.048$)], and that the message was more appealing [$W = 579280$, $p = 0.000$] than the individually framed infographic (Table 5). Moreover, there was evidence that this infographic was considered triggering

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Table 4. Results of the exploratory analysis

Exploratory analysis	*W*	p	Cohen's *d* [CI]
Control group versus individually framed information			
Hard policy support index	702164	0.445	0.009 [−0.07, 0.09]
Personal self-efficacy*	266633	0.033	0.084 [−0.02, 0.18]
Personal outcome expectancy*	247217	<0.001	0.221 [0.12, 0.32]
Collective self-efficacy	271965	0.119	0.060 [−0.04, 0.16]
Collective outcome expectancy*	248706	<0.001	0.222 [0.12, 0.32]
Control group versus collectively framed information			
Hard policy support index*	633193	0.044	0.088 [0.01, 0.17]
Personal self-efficacy*	243579	0.024	0.095 [−0.01, 0.20]
Personal outcome expectancy*	223249	<0.001	0.248 [0.14, 0.35]
Collective self-efficacy	256932	0.407	0.009 [−0.09, 0.11]
Collective outcome expectancy*	205873	<0.001	0.387 [0.28, 0.49]
Individually framed information versus collectively framed information			
Hard policy support index	515787	0.073	0.079 [−0.01, 0.16]
Personal self-efficacy	225571	0.414	0.012 [−0.09, 0.12]
Personal outcome expectancy	222910	0.273	0.029 [−0.08, 0.14]
Collective self-efficacy	233295	0.816	−0.052 [−0.16, 0.05]
Collective outcome expectancy*	207429	0.002	0.166 [0.06, 0.27]

Significant differences (non-parametric one-sided Wilcoxon rank sum *t*-tests, alternative: less) between the three groups are indicated with an * ($p < 0.05$) (hard policy support index: $n = 3{,}389$; personal and collective self-efficacy and outcome expectancy: $n = 2{,}150$).

more reflection than the individually framed infographic [$W = 574218$, $p = 0.001$], and that the use of the collectively framed infographic by the local government was considered a better idea than the individually framed infographic [$W = 562179$, $p = 0.019$].

Participants' reflections on the infographics and the survey (qualitative dataset, n = 847). Complementary feedback on the infographics was collected via the qualitative data. Participants' suggestions to improve the infographics included the use of more colours and pictures, and additional information, for example on biodiversity. Some participants also indicated that it was difficult to respond to questions about the removal of 10 m^2 paving if their garden did not have at least 10 m^2 paving (Supplementary table 8).

Participants' ideas on depaving policies targeting private gardens (qualitative dataset, n = 847). The qualitative data allowed exploring participants' feelings and ideas regarding policies on paving in gardens. In total, 21 categories and 63 concepts (Supplementary tables 9 to 11) were synthesized into a scheme reflecting participants' opinions. The main insights emphasize equitable policy development and positive policy communication (Figure 4).

Participants indicated that paving in gardens is a sensitive topic in Flanders, making it difficult for policy makers to address it or intervene (Supplementary table 9). This is

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Table 5. Results of the infographic evaluation ($n = 2{,}067$)

Likert items	*M*	*SD*	*M*	*SD*
	Collectively framed infographic $n = 997$		Individually framed infographic $n = 1{,}070$	
Infographic itself				
I think the message of the infographic is clear	4.28	0.78	4.24	0.78
The infographic reads smoothly	4.1	0.89	4.14	0.86
I find the message credible	4.34	0.77	4.31	0.79
The message appeals to me	4.36	0.80	4.24	0.84
The infographic has a pedantic tone	2.58	1.08	2.54	1.04
The information from the infographic surprises me	2.19	1.19	2.07	1.10
Use of the infographic				
This infographic shows me the benefits of less paving	4.42	0.72	4.40	0.71
This infographic makes me think about the negative consequences of a lot of paving	4.20	0.88	4.10	0.86
This infographic makes me consider less paving in my garden	3.84	1.02	3.79	1.00
Drawing up and distributing this infographic throughout my city or municipality is a good initiative	4.38	0.82	4.32	0.80

All statements were measured using Likert–scales.

also reflected in various comments, ranging from strong support to strong opposition regarding hard and soft instruments, as well as (de)paving policies in general. Two participants expressed this as follows:

> *They [the government] can and may encourage citizens to depave, but this should not be accompanied by strict controls, fines, compulsory works or taxes.*

> *Although I am absolutely not in favour of laws and regulations, they are necessary in this matter, the seriousness of the situation simply does not get through to a large number of cobblestone heads [figuratively used in a word joke, referring to stubborn people].*

When looking at the effort of depaving, participants highlighted challenges related to the cost-benefit ratio, such as the time and financial resources required, in relation to the impact of reducing paving.

Many participants suggested that a permit should be based on a relative percentage rather than an absolute maximum area of paved area. Participants also suggested several additional policy instruments on (de)paving (Supplementary table 10): financial (e.g. paving tax in a special fund), monitoring (paving inventory), planning (e.g. functional revision of current regulations on front gardens), regulating (e.g. control

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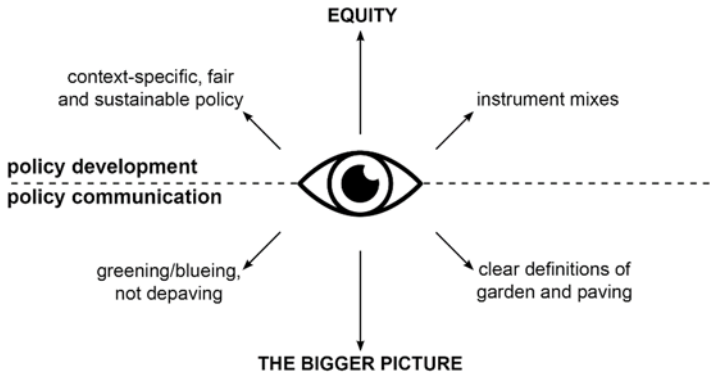

Figure 4. Ideas and feelings on depaving policies targeting private gardens. Scheme synthesizing the results of the open, axial, and selective coding of $n = 847$ comments.

and enforcement), and sensitizing and communication instruments (e.g. good examples and practical tips and tricks). In addition, also policies on water management and increase of garden trees were suggested.

Overall, concerns about perceived fairness and equity were central: everyone should contribute their fair share. One participant formulated it as follows:

> *In Lier [a Flemish city], people are forced to depave their car parking space in their front garden and this while the market place is an enormous stone plain. Furthermore, apartment blocks are springing up like mushrooms. […] That is all unacceptable. The city must set an example.*

Many participants referred to the (regional and local) government's responsibility in managing its own public domain (e.g. parking), and in regulating other actors (e.g. project developers and companies) to realize policy ambitions on depaving and mitigate the result of previous policies. Furthermore, policies should be clear, transparent, well-founded, and sustainable by considering future-proof functional paving. Participants distinctly demanded context-dependent policies, e.g. tailored to physical needs, ownership statute, new housing versus renovation, garden size, and urban versus rural areas.

Government communication is one of the traditional policy instruments that was commented (Supplementary tables 10 and 11). Participants suggested to communicate about greening/blueing, not (only) depaving. They advise that policy should not simply 'take' away the right to pave but rather 'give' something in return, such as a greener garden. Moreover, the paving focus was considered too narrow. Participants indicated that there is more to gardens and water management than just paving. Other important aspects include garden elements that facilitate water infiltration and considerations for biodiversity.

A main comment referred to the definitions of both 'garden' and 'paving'. Participants indicated to only consider a surface as paving if it's run-off water flows into

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the sewer or when the material is fully impervious, e.g. pebbles were often mentioned as being no paving. This is illustrated by a participant's quote:

> *By paving I understand that the water cannot infiltrate the ground but ends up in the sewer. If the water from, for example, the paving stones, can still infiltrate in the ground next to the paving, I think there is nothing wrong.*

Also, paving was considered a too abstract term. Functional units like terrace, pathway, driveway, etc. were suggested for communication. Moreover, a garden appeared to be sometimes interpreted as solely the vegetated part of the parcel behind the dwelling. Driveways, parking, garden sheds, the front garden and terraces were questioned, and not always considered, as part of the garden.

Discussion

Softly depaving the way for hard policies

Private paving is a salient topic for citizens when it comes to climate change adaptation. The unexpected recruitment success of our survey experiment, with over 4,000 initial participants, showed that the issue of private paving resonates with Flemish citizens. For the past years, Flanders got increasingly confronted with droughts, heatwaves, and floodings. Personal experience with extreme weather events has been found to influence people's engagement with climate change mitigation and adaptation, for example in the UK (Demski *et al.*, 2017). Moreover, 2023 was the first year of a Flemish depaving campaign that ended during our survey period. Interest in our survey-experiment may have surfed along with increasing media attention to drought, flooding, heat, and paving, bringing these topics closer to citizens. The large response of 847 participants leaving a comment also signals such feeling of involvement.

Overall, we found evidence that being exposed to the collectively framed infographic increased support for several but not all hard policy instruments targeting private paving. This result is consistent with a study by Vlasceanu and colleagues (2024) who found that exposing participants to examples of successful collective action increased their support for climate policy. We thus demonstrated how collective impact of individual – small – contributions could be communicated effectively to overcome the human bias of self-interest, prioritizing personal over collective outcomes, which often hinders people from engaging in environmental practices (Van Vugt, Griskevicius and Schultz, 2014). The effects, however, were small and the potential of a one-time exposure to efficacy-related information on policy support should not be overestimated. The individually framed infographic did not significantly affect participants' policy support and for one policy instrument (financial contributions) it was even significantly less effective than the collectively framed infographic.

The effectiveness of collective framing even spills over into self-efficacy (personal and collective), as well as outcome expectancy (collective). It strengthens citizens' belief not only in their own ability to actually make a difference, but also in the collective power of society to tackle climate issues. These findings also suggest that the collectively framed infographic works most likely by communicating about effectiveness of collective behaviour change, e.g. via collective outcome expectancy. So, although the

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collectively framed infographic highlights information from a regional – thus more distant – perspective, the emphasis on the collective dimension may have promoted participants' efficacy beliefs (Druckman, 2001).

Collectively framed infographics can thus help to 'soften up' the issue of private paving by building support for it, and by providing a context in which policy entrepreneurs can work towards a final coupling of policy solutions, policy problems and political opportunities (Blum, 2018). Future research can test whether this would also be the case in other policy fields.

Differentiating hard policy instruments: insights for policy design

The most likely explanation for the fact that the effect of the framed infographics was not significant across all policy instruments might be chance variation. Alternatively, the lack of a significant effect of the infographics on citizens' support for stricter control and enforcement may also be due to the observation that citizens think it is unlikely to implement this instrument in a correct way. Our framed infographics do not address citizens' disbelief in control and enforcement on private paving. As one participant commented:

> *An obligation of unpaved surface in the environmental permit is quite recommended, only, and that has become sickly in Belgium, there is no control or hardly any control on that kind of regulation, in other words, one cannot work without the other.*

When imposing regulations and permit obligations, an important yet contentious aspect is ensuring compliance, which is typically achieved through control and enforcement mechanisms. The development of a compliance culture that is supported by the public seems to be one of the policy challenges when it comes to dealing with private paving and requires tailored message design.

A subsidy received the highest support in our study, which is in line with findings across Europe (Zhang *et al.*, 2024). Since subsidy support is already high, there seems less potential for increasing it using the framed infographics. An alternative explanation for the ineffectiveness of the used frames may be that support for policy instruments differs depending not only on how the instruments were presented to the public but also across policy goals, as shown by Andersson and Almqvist (2022). Although subsidy support is generally high, granting subsidies that appear to personally benefit individuals in the strictly private sphere of the garden seems to be questioned by citizens. This is reflected in the qualitative data by a participant who simultaneously commented on control and enforcement as well as subsidies:

> *In my municipality there has been a lot of paving over the recent years, without any control. There is a permit requirement, but everyone does what they want, there is no control anyway. It is too crazy then that subsidies are then awarded to the same people to depave again.*

The framed infographics may not have been effective in addressing such connotation of a government paying for personal pleasure. Since participants did comment on

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the need of some kind of support to overcome practical constraints of depaving, such as logistic or financial assistance, it would be interesting to consider a more efficient use and reallocation of existing resources (Dewaelheyns *et al.*, 2016), supported by an effective way to highlight the collective outcomes of an individual subsidy.

Surprisingly, the largest effect was found for the introduction of a financial contribution (collectively framed infographic compared to no information). A study on climate policy support across different contexts found that policy support for taxes is lower when these are directed towards private consumption than towards industry (Harring *et al.*, 2019). The qualitative data also illustrates this difficulty of raising support for a financial contribution in the private sphere, as a participant clearly states:

> *I have a lot of trouble with the idea that there would be a tax on paving in the garden/private domain. I am convinced that it is very necessary to depave, but the government should first stop throwing the money out of windows and doors before levying new taxes.*

Yet, with the highest proportion of (strong) opposition and lowest mean acceptance score in the control group (which is in line with other studies), this instrument offered the most capacity for increasing acceptance via framed messages. Gravert and Shreedar (2022) have already shown the need of green nudges to increase support and effectiveness of taxes. Participants in our study did however specify preconditions, for example:

> *Regarding question about a financial contribution from owners with paving in the garden: completely agree if this 'tax' comes in a separate fund and not in the big government pot. So transparency is very important.*

Besides additional insights on individual hard policy instruments, the qualitative data also made clear that simply framing facts and figures in government communication will likely be insufficient to raise support for implementing hard climate policies on private paving. Policy design should address citizens' concerns on equity, fairness, future-proofness and context-specificity. Especially perceived (in)equity seems to play a crucial role in this, as citizens view their own responsibility to address climate change within the broader context of shared responsibilities, alongside companies and governments. Perceived fairness was also found by Bergquist and colleagues (2022) as an important determinant of public opinion about climate change taxes and laws in their meta-analysis including 33 countries, while Coleman and colleagues (2023) found that Swedish citizens support climate policies on renewable fuels when costs are broadly shared, including the policy adoption by other units of government at various scales. Therefore, companies and governments should also be included in a depaving policy with their efforts communicated to positively influence citizens' collective outcome expectancy and sense of equity. Such insights in why people support or oppose climate policies are key in developing feasible interventions, especially in strictly private sphere behaviours such as gardening.

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Framing collectivity in an effective way

Since the collectively and individually framed infographic were developed as similar as possible upon the same infographic, their differences in effectiveness relate to the individual versus collective perspective expressed via wordings and numbers.

In our wording, we used the first-person plural 'we' to convey the message that all gardeners are part of a community (called the 'we-group' or 'in-group' by Sumner (1907)) that can make significant collective impact through behavioural change (Christiano and Neimand, 2018). One participant, who received the individually framed infographic, even reflected upon an added value of emphasizing the communal aspect by presenting the information in a more collective way:

> *'Do it for yourself' is an original message that may appeal more to people in an individualistic society than 'we do it together, for each other', but the latter seems to me to be a more useful message to convey, certainly if it were municipalities that would distribute this infographic. Local community building and solidarity (and social pressure/motivation) is the key to success, it seems to me…*

Future research could study possible mechanisms behind the framing effects of different third-persons plural 'we' (in-group), and 'they' and 'people' (out-group). Moreover, the collective frame may simply be more impressive because of the cumulated numbers. The quantitative evidence shows that the collective infographic performed better than the individual one in presenting surprising information and triggering reflection.

Regardless the collective or individual perspective when framing, our qualitative data shows that the choice of facts and numbers presented to the public should be well-deliberated. This seems self-evident, but especially in the context of climate change the trade-off between socio-ecological complexity and comprehensibility proves extremely challenging. In the light of our infographics' focus on the relation between depaving and gain of rainwater, it was an understandable opinion of participants that paving is a non-issue when run-off flows into the garden or in the case of pebbles. This focus however left out other climatic and environmental issues related to paving such as heat absorption, soil compaction, and habitat loss. Hence, by presenting just one aspect of a system, we limited participants in seeing and considering the bigger picture. When designing government infographics to support hard policy measures, the selection of presented facts and figures is ideally tested and evaluated for its restrictiveness and comprehensibility within a broader public.

Limitations

Our study was designed as an online survey experiment, which comes with typical limitations. While a controlled experiment allows for clear comparisons between different conditions to identify general principles underlying policy support (internal validity), its findings are not necessarily generalizable to the whole population nor to real-life situations, other regions or other policy domains (external validity) (James *et al.*, 2017).

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Given our sampling approach and the unexpected success of our survey, it is plausible that people with increased interest in (climate-friendly) gardening were overrepresented in our sample. Such people may be more sensitive to the information we presented, but we deem it equally likely that this sampling bias led to an underestimation of the effect as people who are very interested in the topic might already be aware of the information we provided. Yet, convenience samples are considered adequate for estimating treatment effects, even if they are not representative (Weinberg *et al.*, 2014; Mullinix *et al.*, 2015; Coppock *et al.*, 2018). Infographic effects might also have been inflated by differential dropout, which led to a larger sample size in the control group ($n_{\text{control}} = 1{,}318$) compared to the groups that were shown an infographic ($n_{\text{collective}} = 1{,}002$, $n_{\text{individual}} = 1{,}069$). Participants with little interest in the topic or low general motivation (who might also score lower on policy support questions) might have dropped out before the outcome measures in the infographic conditions, but not in the control condition.

When considering the generalizability of the estimated effects to real-world situations, it is likely that people are less susceptible to message details. However, it would be valuable to test this assumption. For example, Hainmueller and colleagues (2015) found that effects estimated from survey experiments aligned well with those from a real-world behavioural benchmark. As a next step, our infographics could be included in an actual government communication campaign as part of what Fels (2022) calls a collaborative field experiment. This would allow testing the robustness of our insights in a real-life setting and across different audiences, including climate-sceptics, who are challenging to engage through convenience and purposive sampling.

At the planning stage, we anticipated the effect of our framing interventions to be small and designed our sampling plan accordingly. Thanks to the unexpected success of our survey, we could include almost the sevenfold of our preregistered sample size. This allowed us to discover even smaller effect sizes at a high level of precision, which would not have been possible using the preregistered sample size. This illustrates that framing effects might be smaller than generally believed, and future framing studies will likely require sample sizes that are at least as large as in the present study.

A final limitation to consider refers to the survey questions and their interaction. We used the arbitrary area of 10 m^2 to make the outcome of depaving in the infographics as well as the self-efficacy statements in the survey as tangible as possible for the respondents. The qualitative data highlighted an important issue related to this. Although the specified area was not intended as a hypothetical paving limit, many participants interpreted it as an actual policy goal:

> *You suggest that 10 m^2 paving should be the max in a private garden.*

> *Instead of 10 m^2 as a standard, I would rather opt for a percentage for possible paving depending on the garden size, built-up area, subsoil and location.*

This may have influenced their responses to the remaining questions. Future research could consider such interactions. Since the qualitative data also pointed

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towards different interpretations of 'garden' and 'paving', more insights on these different perceptions would benefit clear and fair paving policies.

Conclusions

'Yes, we can'. Developing policies that target garden paving is a challenging task, especially in the context of climate change policies. Main challenges include building support for hard policy instruments and convincing people that their individual contributions truly matter. Our study shows that policy makers should not be reluctant to think about climate policies on paving in private gardens. Moreover, it suggests that citizens can be motivated to support such hard policy measures, if it is demonstrated that collectively they do make a difference. Such collective framing also generates a small but valuable spillover effect on people's efficacy beliefs. Finally, policy makers should give citizens' demand of equity full recognition when developing and designing garden policies.

By using a mixed method approach combining both quantitative and qualitative data from an online survey experiment, we gained an enriched understanding of public support for hard climate policies, which is valuable for both researchers and policymakers. Both actors can build, even collaboratively, on our collectively framed infographic by including governmental efforts while balancing comprehensibility and complexity. Expanding a survey experiment with a qualitative component proved fruitful in deepening our understanding of participants' opinions regarding policies on private paving. However, the external validity limitations typical of survey experiments remained and should be considered accordingly. This research contributes to the field of behavioural public policy by suggesting how policymakers can frame government messages to increase support for necessary but often unwanted hard policy measures.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/bpp.2025.6.

Data availability statement. The data that support the findings of this study are published at the KU Leuven Research Data Repository and made openly available under the CC-BY-4.0 license (https://doi.org/10.48804/C2JTKS). The preregistration is openly available at Open Science Framework (OSF) Registries (https://doi.org/10.17605/OSF.IO/EV8YP). The original infographics are available from the corresponding author upon request.

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Competing interests. The authors declare none.

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