

**Governance Reforms and Public Acceptance of Regulatory Decisions:
Cross-National Evidence from Linked Survey Experiments on Pesticides
Authorization in the European Union**

Jonathan Zeitlin

Department of Political Science, University of Amsterdam, Amsterdam, the Netherlands

David van der Duin

Department of Economics and Public Administration, Ghent University

Theresa Kuhn,

Department of Political Science, University of Amsterdam, Amsterdam, the Netherlands

Maria Weimer

Amsterdam Centre for European Law and Governance, Faculty of Law, University of
Amsterdam, Amsterdam, the Netherlands

Martin Dybdahl Jensen

Research Master Social Science, Faculty of Social and Behavioural Sciences, University of
Amsterdam, Amsterdam, the Netherlands

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Abstract

Do governance reforms affect public acceptance of regulatory decisions, and if so, how? We tackled this critical but under-studied question through a pair of linked survey experiments on public attitudes towards the reform of EU pesticides regulation among a representative sample of the adult population in six EU member states. First, we conducted a conjoint experiment to study whether and how the specific design of decision-making procedures impact public support for EU pesticide regulation. We asked respondents to rate and choose between randomly assigned decision-making packages, covering five dimensions of proposed reform of EU pesticides authorization. In a second linked experiment to analyze how regulatory decision-making procedures impact the acceptance of their outcomes, we asked respondents whether they believed that farmers should be allowed to use glyphosate, the best known and most controversial pesticide. We then showed respondents one of the decision-making packages that they had rated most highly, and asked them if they would be prepared to accept an authorization decision on glyphosate contrary to their prior expressed preference if it were taken under the regulatory decision-making procedure they supported. The results clearly demonstrate that the adoption of a regulatory decision-making procedure that people (strongly) support makes them substantially more willing to accept (or not oppose) a hypothetical authorization decision contrary to their prior expressed preference. Contrary to the findings of previous research, our study thus provides strong evidence that governance reforms that citizens substantively support can enhance acceptance of EU regulatory decisions that run counter to citizens' prior expressed preferences, even on highly contentious and politicized issues such as the authorization and use of pesticides.

1. Introduction

Do governance reforms affect public acceptance of regulatory decisions on controversial and politically salient issues such as pesticides authorization? If so, how do they do so, and under what conditions? Despite the evident importance of these questions for current policy debates across a wide range of political settings, there has been surprisingly little empirical research on them to date.

Most previous empirical studies focus on the relationship between transparency and/or procedural fairness (notably inclusive participation of affected parties) of decision-making processes on the one hand, and respondents' assessments of the legitimacy of these processes or trust in governmental authorities, which are expected to lead to increased public acceptance of decision-making outcomes on the other.¹ Transparency can refer to the provision of detailed

¹ For a good recent review of this literature, see Beyers & Arras (2021). On the broader relationship between procedural fairness, the perceived legitimacy of authorities and institutions, and public acceptance of their decisions, see Tyler (2006) and the critical discussion in Esaiasson et al. (2016). For empirical studies of the relationship between transparency, legitimacy, and trust in regulatory authorities, see de Fine Licht et al. (2014) and Grimmelikhuijzen et al. (2021) respectively.

information about how decisions were taken (“transparency in process”) or explanation by policy makers of the reasons why they were taken (“transparency in rationale”) (de Fine Licht et al. 2014: 113). Procedural justice is typically defined in this literature as referring to three general characteristics of decision-making processes: “voice”, or “the opportunity for individuals to present their opinions in the decision-making process”; “consistency”, or “the absence of systematic bias in the conduct of the decision-making authorities”, and “dignity”, or authorities’ recognition of “individuals’ status as respected members of society during interactions” (Esaiaasson et al. 2016: 295). As can be seen from this definition, much of the empirical literature on procedural fairness is primarily concerned with individuals’ perceptions of and compliance with authorities’ decisions affecting them personally, rather than broad public policy decisions affecting society as a whole (Leung et al. 2007: 477-8).

The limited body of empirical studies that focuses explicitly on the relationship between the perceived legitimacy of decision-making procedures (procedure acceptance) and public acceptance of their outcomes (decision acceptance) has yielded rather mixed results. Some experimental studies have found that while process transparency has no consistent positive impact, rationale transparency can increase decision acceptance by citizens, though this effect appears to be weaker in more politically sensitive domains, such as public safety (Beyers & Arras 2021: 879; Porumbescu & Grimmelikhuisen 2018; de Fine Licht 2014; de Fine Licht et al. 2014).

Several experimental studies have likewise found that people’s perceptions of the fairness of a decision-making process enhances their willingness to accept the resulting decisions (Esaiaasson et al. 2016, 2017; Porumbescu & Grimmelikhuisen 2018). But most such studies also find that these positive effects of participants’ subjective assessments of procedural fairness on decision acceptance are outweighed by their outcome favorability preferences (i.e. their preferred outcome), which as Esaiaasson and colleagues put it are “still overwhelmingly the strongest determinant of individuals’ willingness to accept authoritative decisions.” These results, they report, “are consistent across regulatory and distributive policy issues, across large-scale democracy and school settings, across comparisons among and within decision-making arrangements, and across vignette and field experiments” (Esaiaasson et al. 2016: 291, 309; cf. also Esaiaasson et al. 2017; Esaiaasson 2010; Leung et al. 2007).

In a similar vein, a recent experimental study of the relationship between procedural fairness and public acceptance of environmental risk management decisions in the United States and Switzerland found that positive assessments of stakeholder participation led to positive assessments of regulatory decisions (“cooperation”) only when the issue was considered by respondents of low importance (medical use of X-rays and radiation therapy in both countries). By contrast, when the risk management issue was considered of high importance (depletion of natural resources in the US, regulation of genetically engineered foods in Switzerland), procedural fairness had no effect on respondents’ acceptance of regulatory decisions, which depended instead on their preferences concerning the policy outcome (Earle & Siegrist 2008).

Finally, another recent experimental study of public attitudes towards environmental regulation likewise finds that balanced stakeholder consultations had a positive impact on participants’ procedure acceptance, but not directly on their decision acceptance, which depended instead on outcome favorability preferences. But some indirect impact could nonetheless be identified,

insofar as procedure acceptance increased decision acceptance among respondents who were more negatively predisposed to government regulation (Beyers & Arras 2021).

None of these studies, however, examine the substantive dimensions of decision-making procedures which are a major focus of public controversy in many areas of contemporary risk regulation, such as the range of legitimate factors to be considered in product authorizations, or the arrangements for post-market monitoring and review of such decisions. It is thus far from clear how far their findings concerning the limited impact of procedural fairness and transparency on public decision acceptance would carry over to the more substantive governance reforms currently being debated in relation to pesticides authorization and other cognate fields of risk regulation in the European Union (EU).

One might expect the burgeoning literature on organizational reputation to have addressed the effects of regulatory authorities' positive or negative reputation (performative, moral, procedural, and technical) on public acceptance of their decisions. But as recent reviews make clear, this literature has focused primarily on the consequences of organizational reputation for bureaucratic autonomy and administrative discretion, together with regulatory authorities' responses to reputational threats, above all from their legislative and executive principals (Carpenter & Krause 2012; Boon et al. 2019; Busuioc & Rimkuté 2020; Binderkrantz et al. 2021). The only empirical study we have been able to identify that investigates the relationship between bureaucratic reputation and citizens' acceptance of regulatory policies is a survey of public attitudes towards the Cypriot Water Authority, which finds that the small minority of respondents who had a negative perception of this body's efficacy and moral reliability were also less likely to comply with its recommendations for water use and support its proposals for costly solutions to water shortages (Capelos et al. 2016). The limited attention to this issue in the organizational reputation literature thus further reinforces our broader claim that public regulatory decision acceptance is an important problem on which there is surprisingly little empirical research.

To bridge this yawning gap, we conducted a pair of preregistered, linked online survey experiments on public attitudes toward reform of EU pesticides regulation among a representative sample of the adult population in six member states: France, Germany, Italy, the Netherlands, Poland, and Sweden, with a sample of 1500 respondents per country.² The aim of these experiments was first to assess whether and how specific actual or proposed reforms to decision-making procedures could impact public support for EU pesticides regulation, and second to assess whether and how reforms of the EU pesticides authorization procedure could impact public acceptance of its outcomes. The results reported in this paper not only enable us to identify which specific reforms to EU pesticides regulation would command strongest public support, but also clearly demonstrate that the adoption of a decision-making procedure that people (strongly) support makes them substantially more willing to accept (or not oppose) a hypothetical authorization decision contrary to their prior expressed preference. Contrary to the findings of previous research discussed above, our study thus provides strong evidence that governance reforms that citizens substantively support can enhance regulatory decisions that

² The preregistration can be found at: https://osf.io/wpt46/?view_only=e6b82a4bfd444a9a87ab10cf439b0fa3.

run counter to their prior expressed outcome favorability preferences, even on highly contentious and politicized issues such as pesticides authorization.

The body of the paper is structured as follows. Section 2 briefly introduces the policy debate on reform of EU pesticides regulation, presents the design and methodology of our first survey experiment on public attitudes towards proposed reforms, and analyzes its results. Section 3 presents the design and methodology and analyzes the results of our second survey experiment on acceptance of a hypothetical pesticide authorization decision taken under respondents' preferred reform package. The final section summarizes our main findings and discusses their implications for the relationship between governance reforms and public acceptance of regulatory decisions more generally.

2. Public attitudes towards reform of EU pesticides regulation: experiment 1

2.1 The EU pesticides regulation debate

The authorization and use of pesticides in the EU have become increasingly controversial and politically salient over the past decade. Glyphosate, the active substance in Bayer/Monsanto's Roundup and the world's most widely used herbicide, was classified in 2015 as a "probable human carcinogen" by the International Agency for Research on Cancer (IARC), leading to large numbers of lawsuits and high damage awards to affected users in US courts (Benbrook 2020). In the EU, glyphosate's re-authorization by the European Commission in 2017 for an abbreviated five-year period was hotly contested, triggering broad public distrust in the adequacy of the current European regulatory framework to ensure a high level of protection for public health and the environment. Such public distrust and ensuing political mobilization were reflected in a European Citizens' Initiative (ECI) to ban glyphosate, which gathered over one million signatures³ in less than five months following the re-authorization decision. "Save Bees and Farmers", a second ECI against pesticides, likewise attracted more than 1.2 million signatures in 2021.⁴ Moreover, several member states and regions have adopted prospective bans on glyphosate, in apparent contravention of EU law, under which authorization of active substances in pesticides should occur at European level.⁵

Such public controversy and political contestation have stimulated a wide-ranging debate about which reforms should be adopted to improve EU pesticides regulation. The key issues raised in this debate include the organization of the decision-making process, notably the division of labor between EU and national authorities; whether other socio-economic and cultural factors should be considered in addition to the effects on human health and the environment when authorizing

³ 1,070,865; under the Lisbon Treaty at least 1 million signatures are necessary to trigger the ECI procedure.

⁴ <https://www.savebeesandfarmers.eu/eng/>; https://europa.eu/citizens-initiative/initiatives/details/2019/000016_en.

⁵ For overviews of EU pesticides regulation and the glyphosate controversy, see Bozzini (2017); Leonelli (2018); Tosun et al. (2019).

pesticides; the sources of evidence used in scientific risk assessments, beyond studies commissioned by the manufacturers; and the extent of post-market monitoring and review of authorized products.⁶ While some reforms have been implemented and others are under discussion, little is known about what the public thinks of them, and whether they could increase public support for both EU pesticides regulation and individual authorization decisions. The issue of public support is crucial for several reasons. First, the current glyphosate authorization expires in 2022 and any future EU decision on its renewal would be undermined by the lack of public trust and acceptance of the decision-making process.⁷ Second, as part of its Green Deal the EU seeks a transition towards sustainable agriculture. The European Commission has recently committed to propose measures to reduce “the risk and use of pesticides by 50%” by 2030, as part of its “Farm to Fork Strategy” for sustainable food systems (European Commission 2020a). Public support is crucial for future EU measures in this field. Yet, as survey evidence shows, citizens’ concerns about the negative effects of pesticides on human health and the environment have increased over the past decade, while satisfaction with EU and national regulation has declined (Zeitlin et al. 2021: 17-20; Eurobarometer 2010).

2.2 Experimental design and methodology

A central aim of reforming EU pesticides regulation is to rebuild public confidence and support. But which reforms would European citizens prefer, and how would their adoption impact public support for EU pesticides regulation? To answer these questions, we conducted a conjoint survey experiment in which a representative sample of respondents from six member states were asked to rank and rate randomly assigned decision-making packages covering five dimensions of proposed reforms to EU pesticides regulation.⁸ This sub-section explains the design and methodology of the conjoint experiment, including the setup of the survey, while the next sub-section analyzes its results.

Survey and sampling procedure

We conducted the survey in June 2020 in six EU Member States: France, Germany, Italy, the Netherlands, Poland, and Sweden, with a sample of 1500 respondents per country, for a total of

⁶ For an in-depth review of the current EU pesticide regulation regime and reform debate, see Zeitlin et al. (2021: 9-16), which draws on a wide range of official and non-governmental sources, including European Commission (2018a, 2018b, 2020b); European Parliament (2019); Pesticides Action Network (2018); Robinson et al. (2020); European Commission, Scientific Advisory Mechanism, Group of Chief Scientific Advisors (2018).

⁷ A draft report by the Assessment Group on Glyphosate (AGG), comprising four national competent authorities appointed by the European Commission to evaluate this application, recommended its renewal in June 2021. Their report will form the basis for public consultations and opinions by the European Food Safety Authority (EFSA) and the European Chemical Agency (ECHA), followed by a proposal for a decision by the European Commission (Assessment Group on Glyphosate 2021). The glyphosate draft renewal report has already sparked fierce public criticism from the Health and Environmental Alliance (HEAL) and a broad range of European, international, and national NGOs (HEAL 2021).

⁸ Both the conjoint experiment and the decision acceptance experiment have been preregistered, including all hypotheses tested in this paper and the specific analytical strategy. However, some changes have been made to the configuration of the hypotheses and the analytical strategy on the basis of new insights since the preregistration. Nonetheless, all hypotheses are confirmed with the original preregistered analysis strategy as well.

9022 respondents. The sample was drawn randomly. However, quotas for demographic categories, derived from Eurostat statistics, were used to ensure that each country sample was representative of the adult population across the following categories: age, gender, education, and NUTS1 region of residence. The data collection was carried out by means of the online panels of survey company IPSOS. The survey was translated into each country's main language, and accessed on personal computers and mobile devices.

Country selection

The countries in our survey were selected to capture as far as possible the variation among EU member states in terms of the following indicators: GDP, size of the agricultural sector, structure of the agricultural sector (the relative size of organic versus intensive farming), average quantity of pesticides used, membership of different agricultural zones as determined by EU regulation,⁹ voting behavior on the related issue of GMO authorization in the Council of the EU, and the duration of the countries' EU membership. Appendix Table A.1 shows the per-country specification of these characteristics, with the exception of voting behavior on GMOs, which can be found in Mühlböck & Tosun (2018). In terms of voting behavior on the re-authorization of glyphosate in 2017 (information about which was not available to us when we designed our survey), two countries in our sample voted no (France and Italy), while four countries voted yes (Germany, the Netherlands, Poland, and Sweden). One country (Germany) changed its vote at the last minute from abstain to positive at the personal insistence of the Minister of Agriculture, provoking a political crisis in the caretaker coalition government (Tosun et al. 2019; Kudsk & Mathiassen 2020). The selected countries thus provide a good cross-section of national positions within the EU on glyphosate re-authorization. In January 2020, the six countries in our survey had a combined population of 255.8 million, comprising 57.2% of that of the EU-27 (own calculations from Eurostat Data Explorer).

Conjoint survey experiments: method and rationale

Conjoint survey experiments are an established method for analyzing respondents' stated preferences on complex and multidimensional issues (Bansak et al. 2021, Hainmueller et al. 2014). They have clear advantages compared to conventional survey designs as they provide finer-grained information on preferences than conventional survey questions and they shed light on how the design of a policy (or programme, candidate, or other subject of interest) influences support. In a nutshell, conjoint experiments ask respondents to rate and rank different hypothetical profiles of policies that randomly vary on a number of crucial dimensions. Conjoint survey experiments thus allow researchers to make causal claims about how the specific design of a policy or programme influences public support (Hainmueller et al. 2014). Researchers can analyze how public support for a policy correlates with variation on specific dimensions, and they can also elicit how respondents deal with trade-offs between specific dimensions that they face

⁹ These zones play an important role in the current pesticide regulation regime. Member states are grouped into three zones (northern, central or southern) according to agricultural, plant health and environmental conditions. Member states are expected to collaborate with the others in their zone in pesticides regulation, while the principle of mutual recognition applies for pesticides only to countries within the same zone. For a map showing the distribution of member states across zones, see European Commission (2018a: 21).

when evaluating different policies.

For these reasons, conjoint experiments have long been a popular method across disciplines such as economics (Hanley et al. 1998), sociology (Jasso & Rossi 1977), and marketing research (Carrol and Green 1995). In political science, they have been used to study a wide range of topics such as public support for international climate (Bechtel and Scheve 2014) and trade agreements (Spilker et al. 2018; Hahm et al. 2020), attitudes towards immigrants (Hainmueller & Hopkins 2015), and support for European unemployment insurance (Kuhn et al. 2020).

While conjoint experiments might seem to overload respondents with too much and too complex information, research suggests that this concern is not warranted as respondents have been shown to give valid and robust answers even in conjoint experiments with unusually high numbers of dimensions and attributes (Bansak et al. 2018).

Our conjoint survey experiment

In our case, the conjoint survey experiment asked respondents to choose between, and rate their preference for, two proposals for the reform of the EU pesticide regulation regime. The experiment was introduced by a frame, which was composed to be as neutral as possible.¹⁰ The text of this frame ran as follows:

Pesticides are chemicals used to prevent pests from damaging food crops and other plants. Many farmers rely on pesticides to grow crops in large quantities at low costs. But pesticides can also have negative effects, for example on human health and the environment.

The European Union and national authorities therefore regulate the use of pesticides. Recently, the procedures for European pesticide regulation have become controversial, and multiple options for their reform are under discussion.

We would like to hear your opinion about different ways to regulate the use of pesticides. In a moment you will be shown alternative procedures for pesticides regulation. You will be asked to indicate which procedures you prefer (or dislike the least), and how much you support or oppose them. People have different opinions about this issue, and there are no right or wrong answers.

Subsequently, respondents moved on to the first iteration of the experiment. Each iteration of the experiment was headed by the text “A manufacturer submits a new pesticide for approval. How should the decision be taken? Please consider the following two options.” Respondents were shown two randomly drawn profiles of decision-making procedures and were subsequently asked to rate and rank the profiles.

The profiles of the conjoint experiment itself varied on five dimensions, with two or three distinct options each. The options shown for each dimension in each proposal were randomly drawn from

¹⁰ Hence we did not provide respondents with information about the current organization of EU pesticide regulation, nor did we ask them about their knowledge of current regulatory arrangements.

a prepared set. An overview of the dimensions and options is shown in Table 1 below. The first four dimensions in the conjoint experiment were designed to cover the key challenges and proposed reforms of EU pesticides regulation identified in our in-depth review of the debate (Zeitlin et al. 2021: 9-16), while also being readily understandable to respondents. Thus, D1 on the level of decision-making takes up a central issue concerning the organization of the decision-making process, namely whether authorization decisions should be taken at the EU level, the national level, or a combination of the two. D2 addresses the debate on which factors should be considered in authorization decisions, by asking whether effects on small and organic farmers and/or on the international competitiveness of European agriculture should be taken into account. D3 deals with the sources of evidence to be considered in risk assessments, asking whether only studies commissioned by the manufacturer, all relevant scientific studies, or only studies carried out by an independent public body should be taken into account. D4 takes up the question of whether there should be systematic post-market monitoring and review of authorized pesticides, with the possibility of withdrawing products from the market in case of unanticipated negative effects. D5 on the possible effects on food prices is included in the conjoint experiment as a discipline on respondents' support for proposed reforms to EU pesticide regulation, encouraging them to reflect on possible trade-offs between the costs and benefits of a given policy package. The numerical amounts of the increase in food prices (1 percent and 3 percent) are purely hypothetical, as it is extremely difficult to predict with any degree of accuracy the likely economic impact of regulatory reforms, especially in the longer term, as farmers and manufacturers develop alternatives to existing chemical pesticides.

Table 1. Overview of conjoint experiment dimensions and options

| | |
|---|---|
| D1 At what level is the decision taken? | <p>The European Union level only.</p> <p>The national level only.</p> <p>A combination of the EU and national levels.</p> |
| D2 What other factors are considered in the decision, in addition to the effects on human health and the environment? | <p>The effects on small and organic farmers.</p> <p>The effects on the international competitiveness of European farmers.</p> <p>No additional factors</p> |
| D3 What sources of scientific evidence are considered in the decision? | <p>Only scientific studies conducted on behalf of the manufacturer.</p> <p>All relevant scientific studies.</p> <p>Only scientific studies conducted by an independent public body.</p> |
| D4 If the pesticide is approved, are its effects systematically monitored? | <p>No systematic monitoring after the approval decision.</p> <p>Yes, there is systematic monitoring, with the possibility of removing the pesticide from the market in the case of unexpected negative effects.</p> |
| D5 How will this decision-making procedure affect food prices? | <p>Food prices will stay the same.</p> <p>Food prices will rise by 1%.</p> <p>Food prices will rise by 3%.</p> |

After each iteration of the experiment, respondents were asked three questions. First, they were asked which of the two proposals they preferred, resulting in a proposal choice variable. Second, they were asked how much they support the first proposal, with 5 answer categories ranging from “strongly oppose” to “strongly support”, resulting in a proposal rating variable. Third, they were asked how much they support the second proposal. The Appendix shows a concrete example of what the experiment looked like for respondents.

The exercise was repeated three times, so that each respondent ranked three profile pairings and rated six profiles in total. In addition to the options for the dimensions, the order in which the dimensions appeared was also randomized with the single exception of the “food price” dimension (D5), which always appeared last to avoid confusion among respondents. At the same time, however, the order in which the dimensions were shown to each respondent did not change across successive iterations of the experiment.

The survey also included questions forming the main variables of the second (decision

acceptance) experiment, discussed below, and the control variables. These include age, gender, education level and income. A detailed discussion of the operationalization of all variables used in the analyses of this paper can be found in the Appendix. Our preregistered hypotheses about respondents' preferences on these dimensions, which were based on our interpretation of the EU reform debate, can be found in the Appendix.

2.3 Results

In what follows, we analyze proposal support, which equals 1 if the proposal rating variable is 4 ("somewhat support") or 5 ("strongly support"), and 0 otherwise. Since the levels of the dimensions are completely randomized across iterations of the experiment, the models can be estimated using OLS regression (Hainmueller et al. 2014), including robust standard errors at the respondent level.¹¹ In addition, all findings presented below come after controlling for age, gender, education (8-level ISCED classification), income (subjectively rated on a 5-point scale) and country-level fixed effects. The operationalization of these control variables is presented in the Appendix.

Figure 1 tells us how each characteristic of the reform proposals individually influences support for the reform. Following established standards in conjoint analysis, Figure 1 shows "average marginal component effects" (AMCEs) for each dimension in the full sample of 9000 respondents across the six countries. "The AMCE measures the average causal effect of changing the treatment for a given dimension on the likelihood that a package will be supported or chosen, holding the treatments for all other dimensions the same" (Beetsma et al. 2020: 19). A positive AMCE means that a particular characteristic increases support, while a negative effect refers to decreasing support. The statistical analysis underlying this figure can be found in Appendix Table A.2, including information on the (mostly negligible) effects of the individual control variables. Robustness checks are discussed in the Appendix.

¹¹ To test the robustness of this analysis, the models have also been estimated using logistic regression. These results lead to the same conclusion as the results from the OLS regression, and can be found in Appendix Table A2.

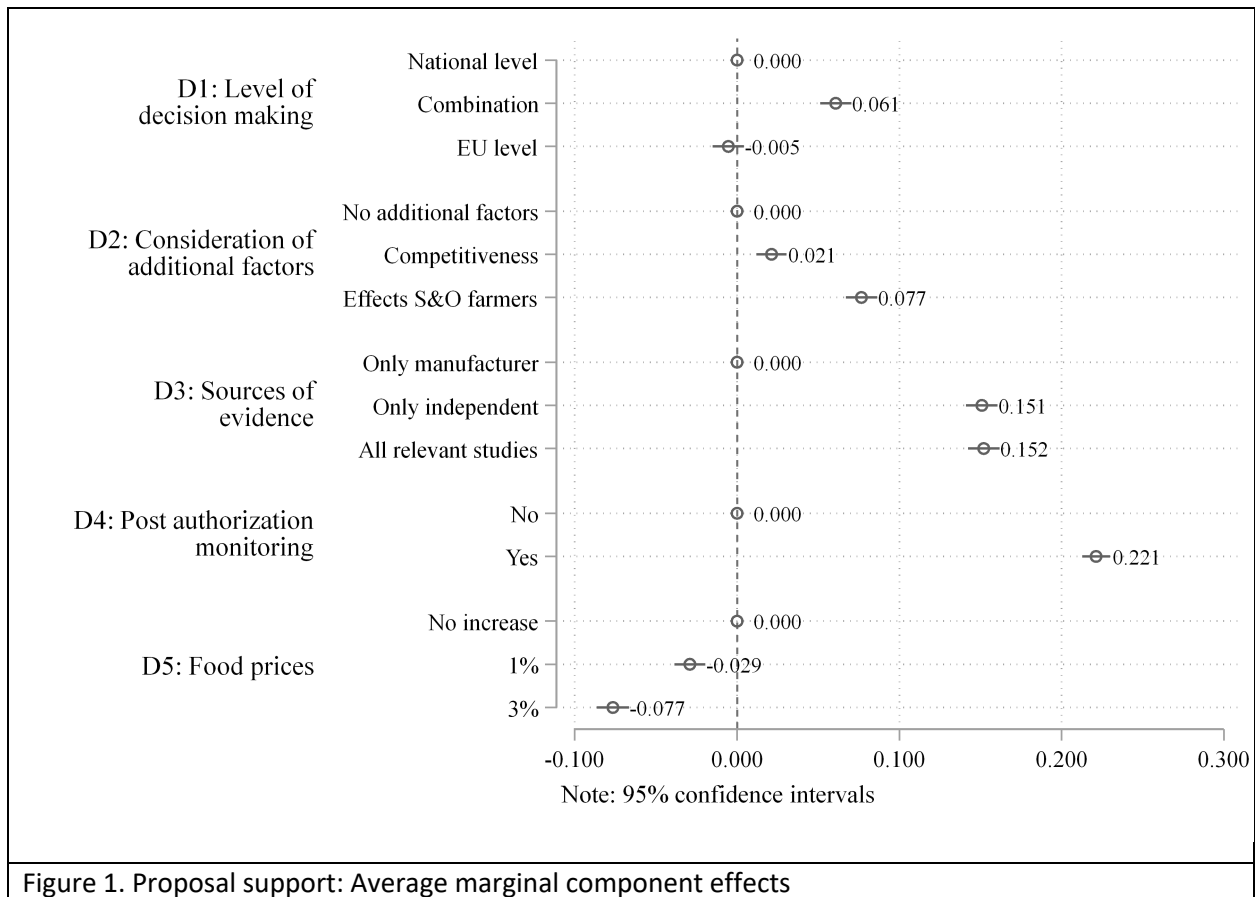


Figure 1 shows that citizens' support for pesticide regulation heavily depends on how regulation is organized. The strongest effect (holding all else constant) concerns post-authorization monitoring and review, whose inclusion in a proposed reform package increases the probability of support by 22.1 percent. The second strongest effect concerns the sources of evidence to be considered in authorization decisions: inclusion of all relevant scientific studies or only studies conducted by an independent public body, as opposed to only studies conducted on behalf of the manufacturer, increases the likelihood of proposal support by 15.2 and 15.1 percent respectively. Consideration of the effects on small and organic farmers (in addition to the effects on human health and the environment) in pesticides authorization decisions increases the probability of support by 7.7 percent, while inclusion of the effects on the international competitiveness of European agriculture increases the likelihood of support by 2.1 percent. Taking authorization decisions at a combination of the EU and national levels (the current status quo) increases the probability of support for a proposed policy package by 6.1 percent relative to decision-making at the national level alone. In contrast, moving the decision to the EU level decreases the likelihood of support by 0.5 percent, but this effect is not statistically significant. Conversely, a projected 3 percent increase in food prices decreases the probability of support for a reform proposal by 7.7 percent, while a projected price increase of 1 percent decreases the likelihood of support by 2.9 percent. All of these effects are even stronger for proposal ranking (indicating which proposal within each pair respondents preferred) than for proposal support

(the rating respondents gave to each proposal). As Figure 1 shows, all of these findings confirm our preregistered hypotheses about respondents' preferences, provided in the Appendix.

Figure 1 shows results for all countries in our study. In addition to the pooled sample, we calculated AMCEs for each dimension separately for each of the six countries in our sample. The results (not shown) diverged remarkably little from those for the sample as a whole, with slightly weaker support (-2.5 percent) in Sweden for decision making at the EU level only and stronger support (+6.7 percent) in the Netherlands for consideration only of scientific studies conducted by an independent public body as the biggest outliers.

While Figure 1 showed how support depends on particular characteristics of the reform proposals, we can also estimate the level of support for specific policy packages, i.e. combinations of characteristics. Figure 1 shows that the most popular reform package would comprise authorization decisions taken jointly at EU and national levels, consideration of effects on small and organic farmers, inclusion of all relevant scientific studies in risk assessments, and systematic post-authorization monitoring and review, with the possibility of removing pesticides from the market in the case of unexpected negative effects. Calculating the predictive marginal level of support at these dimension characteristics while holding other variables constant shows that this policy package would command the support of 72.3 percent of respondents in our survey. Moreover, even if this reform package were expected to lead to a 3 percent increase in food prices, it would still be supported by 64.7 percent of all respondents.

3. Regulatory governance reforms and public acceptance of pesticide authorization decisions: experiment 2

The results of our first survey experiment show that citizens in six EU member states have clear and strong preferences about how pesticides should be authorized and regulated. But are citizens prepared to accept authorization decisions taken under a regulatory governance procedure they support, even when such decisions go against their prior expressed preferences on policy outcomes? In other words, can procedure acceptance lead to decision acceptance even under contrary outcome preferences? To tackle this question, we conducted a second linked survey experiment on acceptance of pesticide authorization decisions, testing two main hypotheses about the relationship between respondents' attitudes towards regulatory governance reform and pesticide decision acceptance:

H1: If the hypothetical glyphosate authorization decision opposed to respondents' prior expressed preference is based on a decision-making procedure proposal that they support, respondents are more likely to accept this decision than if it is not based on a procedure they support.

H2: The stronger the support for the decision-making procedure on which the hypothetical glyphosate authorization decision opposed to respondents' prior expressed preference is based, the more likely they are to accept this decision.

These hypotheses are consistent with the literature on the relationship between procedure

acceptance and decision acceptance discussed in the introduction, notably the work of de Fine Licht (2014), de Fine Licht et al. (2014), Porumbescu & Grimmelikhuisen (2018), and Beyers and Arras (2021), which find that citizens' perceptions of the transparency (especially in terms of reason-giving explanations by policy makers) and procedural fairness (especially in terms of inclusive stakeholder consultation) can enhance their willingness to accept the resulting decisions. Our novel experimental design further allows us to test whether this positive relationship between procedure acceptance and decision acceptance also holds for a highly salient and politicized issue such as pesticides regulation, and can offset or even outweigh citizens' prior expressed preferences on decision outcomes, in contrast to the findings of previous studies discussed above such as Earle & Sigrist (2008), de Fine Licht (2014), de Fine Licht et al. (2014), Essaisson et al. (2016, 2017), and Beyers & Arras (2021).

In addition to these two main hypotheses concerning the full sample of respondents, we further expect there to be an asymmetry in the likelihood of decision acceptance between those who previously expressed opposition to farmers' being allowed to use glyphosate, compared to those who expressed a positive preference or had no opinion on this question. This expectation is based on extrapolation from recent experiences with oppositional campaigning around highly politicized issues such as the Transatlantic Trade and Investment Partnership (TTIP) between the EU and US. There, major concessions by the European Commission in response to criticisms from civil society organizations on both substantive and procedural issues (notably transparency of negotiation documents, design of the investor protection mechanism, and regulatory cooperation arrangements) failed to placate opponents of the proposed treaty once they had been mobilized (Young 2017: ch. 5; Heldt 2020; Gheyle & De Ville 2017). Since the re-authorization of glyphosate is also a highly politicized issue, we expect a similar dynamic to apply here. This reasoning leads to the following hypothesis:

H3: People who believe that farmers should not be allowed to use pesticides containing glyphosate are less likely to accept the result of a hypothetical authorization decision opposed to their prior expressed preference than those who support the use of pesticides containing glyphosate.

We further expect that the most important predictors of respondents' unwillingness to accept a hypothetical approval of glyphosate taken under a regulatory decision-making procedure they support are their environmental ideology, their expressed level of concern about pesticides, and the degree to which they think that EU pesticides regulation should be precautionary. Existing literature has generally concluded that individuals' ideological orientation are an important determinant of their support for or acceptance of environmental policies. Thus a substantial body of research has shown that left-leaning people tend to hold more positive attitudes towards environmental protection than those leaning to the right, though some recent studies have found that this relationship may vary depending on the specific policy issue (e.g. nature conservation vs. climate change) and the type of measures involved (e.g. regulation, taxes, or pricing mechanisms) (Ejelöv & Nilsson 2020; Jagers et al. 2018; Haring et al. 2017; Haring & Sohlberg 2017). The main pathway through which political orientation is believed to influence general attitudes towards environmental policies is through the relative priority given by left and right-leaning individuals to environmental protection versus economic growth (Jagers et al. 2018: 87; Haring

& Sohlberg 2017: 281). We term this relative priority of environmental protection versus economic growth “environmental ideology” and measure it directly through responses to a specific item in our survey. To capture the role of attitudes specific to this policy field, we also investigate the influence on respondents’ decision-acceptance preferences of their levels of concern about pesticides and their degree of support for more or less precautionary approaches to pesticide authorization. Again, a detailed discussion of the operationalization of these variables can be found in the Appendix. This reasoning leads to the following three hypotheses:

H4: People who prioritize environmental protection over economic growth are less likely to accept the approval of glyphosate as the outcome of the hypothetical authorization decision than are people who give equal importance to these goals or who prioritize economic growth.

H5: The lower people’s concern about pesticides, the more likely they are to accept the approval of glyphosate as the outcome of the hypothetical authorization decision.

H6: People who prefer the regulation of pesticides to be more precautionary are less likely to be willing to accept the approval of glyphosate as the outcome of the hypothetical authorization decision than people who prefer the regulation of pesticides to be less precautionary.

The next two subsections of the paper first explain the design and methodology of the experiment, and then analyses its results.

3.1 Design and methodology

Following the conjoint survey experiment on public attitudes towards reform of EU pesticides regulation, respondents were exposed to a second survey experiment designed to investigate the acceptance of regulatory outcomes opposed to prior preferences under a supported decisionmaking procedure. To introduce this experiment, respondents were first asked whether they had previously heard about glyphosate, to which they could answer “yes”, “no”, or “don’t know”. Next, respondents were asked whether they think farmers should be allowed to use pesticides containing glyphosate, to which they could respond with the same set of answers. This was followed by the second experiment in which respondents were first asked to review one of the proposals that they had supported most during the conjoint experiment, which was shown to them at the top of the page for this experiment.¹² As such, the specific proposal shown in this experiment was different per individual, depending on the preferences expressed during experiment 1. Depending on their answer to the previous question (whether they support the use of pesticides containing glyphosate by farmers or not), respondents were assigned to one of two versions of this experiment. If they answered “no” to the previous question (i.e. they oppose the use of pesticides containing glyphosate by farmers), they were assigned to the “approval version”. If they answered “yes” to the previous question (i.e. they support the use of pesticides containing glyphosate by farmers), they were assigned to the “ban” version. Respondents who answered “don’t know” to this question are excluded from the analyses presented below, while the Appendix discusses results for these respondents.

¹² If respondents rated multiple packages equally highly, one of these most highly rated packages was chosen at random for this experiment.

The approval version of the experiment asked respondents the following question: “Above you can see one of the decision-making procedures you rated most highly. Would you be willing to accept the approval of glyphosate if the decision was based on this procedure?” The ban version conversely asked respondents the following question: “Above you can see one of the decision-making procedures you rated most highly. Would you be willing to accept a ban on glyphosate if the decision was based on this procedure?” In both versions, respondents could respond “yes”, “no”, or “don’t know”. For our analyses, we pool both versions of the experiment, and treat the answers to the different questions asked as a single variable. Due to the assignment procedure based on prior support for or opposition to glyphosate usage by farmers, the answer “yes” indicates willingness to accept a pesticide authorization decision contrary to one’s prior preferences for both the approval and the ban scenario. Similarly, the answer “no” indicates an unwillingness to accept the authorization decision regardless of the specific scenario presented to respondents. As such, the answers in the two experiment versions together form the main dependent variable of the decision acceptance investigation, called “acceptance”. In the analysis presented below, this “decision acceptance” variable is treated as an ordered variable, with “don’t know” being considered as the middle category between “no” and “yes”. Accordingly, the analysis presented below uses ordinal logistic regressions.

Considering the setup of the experiment, it should be noted that individual preferences for the decision-making procedure are taken into account by default in the experimental design, as respondents were presented a package that they had supported the most (or opposed the least) during experiment 1. Nonetheless, this design allows for variation in the level of support for the package reviewed during experiment 2 across respondents, as for example for some respondents the most supported proposal could be rated as “oppose” (2), while for other respondents the most supported proposal could be rated as “strongly support” (5).

A schematic overview of the setup of experiment 2 is shown in Figure 2, and a screenshot taken from a test environment showing what this experiment looked like for respondents can be found in Appendix Figure A2.

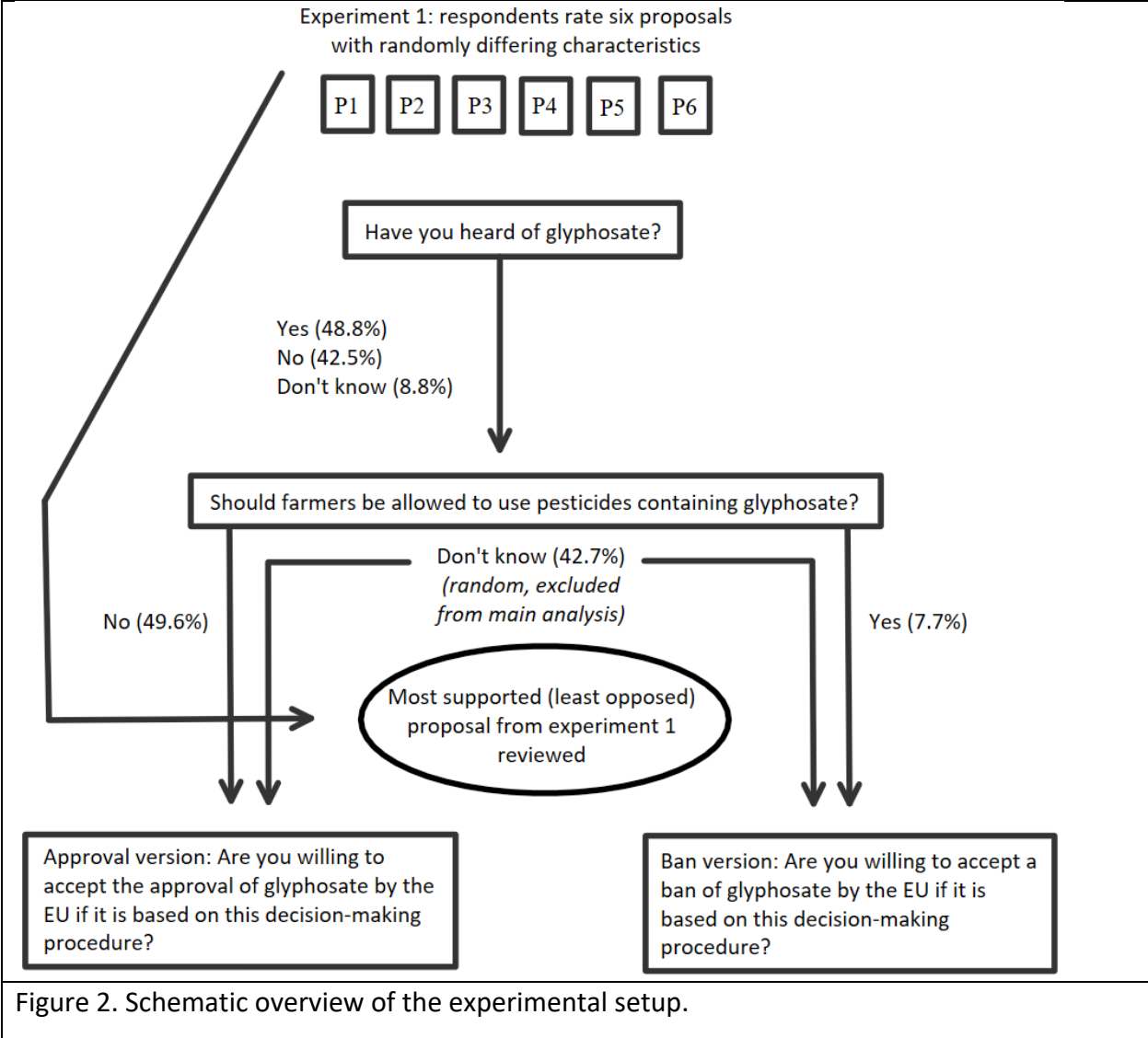


Figure 2. Schematic overview of the experimental setup.

While respondents exposed to the different versions of the experiment will be pooled in the following analyses, as discussed above, we control for the scenario presented to respondents. Additionally, all models control for political ideology (left-right), age, gender, education level, subjectively assessed income, and attentiveness (as measured with an attention check at the end of the survey). Country-level fixed effects are included to control for country-level heterogeneity, but are not shown in the results presented below. Moreover, for some variables we expect the direction of their influence to depend on the scenario. For example, following the literature discussed above, we would expect a more left-wing political orientation to reduce acceptance in the approval scenario, but to increase acceptance in the ban scenario, and vice versa for right-wing ideology. These variables are interacted with the scenario type in order to account for such heterogeneous effects.

The analyses presented below exclude those who responded “don’t know” (42.7% of the sample), as mentioned above. However, respondents are included irrespective of whether they

said that they had previously heard about this pesticide. Since nearly one-third of respondents (32.9%) who had not heard of glyphosate (or were not sure whether they had) nonetheless expressed an opinion about whether farmers should be allowed to use it, we consider that they should be included in the analysis, in order to reflect the full distribution of views within the population which impact regulatory decision acceptance.¹³

3.2 Results

Table 2 shows the results of the ordinal logistic regression. As the control variables in Table 2 show, the proportional odds of being in a higher category of acceptance (“don’t know” or “yes” versus “no”, or “yes” versus “no” or “don’t know”) are higher among those with a higher subjectively assessed income, while they are lower among older and female respondents. As expected, the effect of political ideology depends on the experiment scenario: in the approval scenario (the base condition), higher values on this variable, indicating right-wing attitudes, are associated with higher odds of acceptance, while the reverse is the case for lower values (indicating left-wing attitudes) in the ban scenario. Education level and attentiveness do not have a significant effect on decision acceptance.

More importantly, models 1 and 2 show that hypotheses 1, 2 and 3 are all confirmed. The proportional odds of accepting the authorization decision opposed to prior preferences (model 1) are higher by a factor of 2.1 for respondents who are presented with a decision-making procedure that they support compared to respondents who are presented with a procedure that they do not support, holding all other variables constant. Moreover, the higher the rating given to the most preferred proposal package (model 2), the higher the respondents’ odds of decision acceptance, and the lower the odds of non-acceptance. Figure 2 presents the results of the analysis for H2 graphically, showing how respondents’ predicted probability of decision acceptance is higher while the predicted probability of rejection is lower the higher is their level of support for the most preferred package. It also shows how the probability of don’t know answers is higher with a higher level of support for the preferred package, indicating that a neutral position on the decision instead of a rejection is more likely the stronger the support.

Table 2. Ordinal logistic regression of decision acceptance

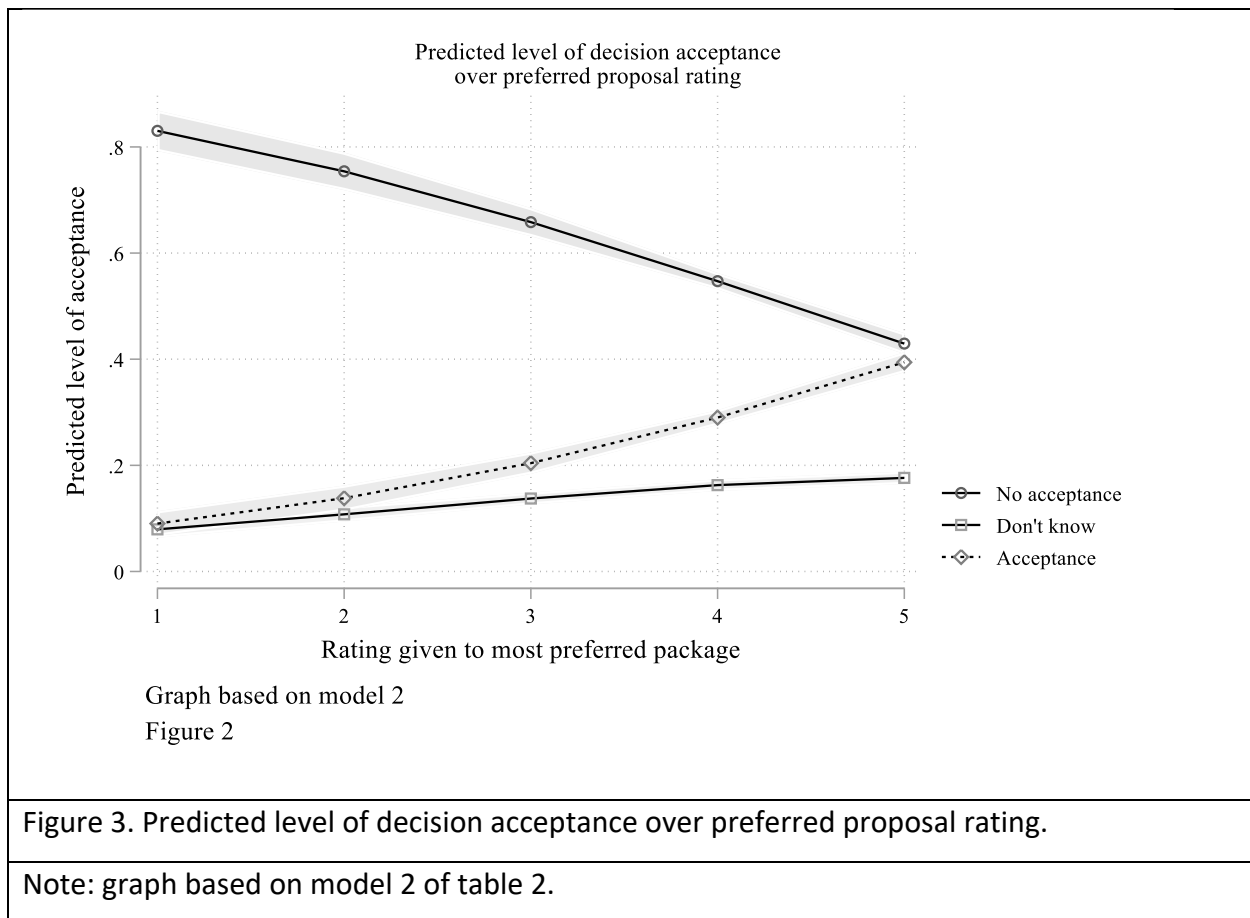
| | Model 1 | | Model 2 | | Model 3 | |
|--|----------|---------|----------|---------|----------|---------|
| | OR | s.e. | OR | s.e. | OR | s.e. |
| Support most preferred package | 2.082*** | (0.213) | | | | |
| Rating given to most preferred package | | | 1.681*** | (0.075) | 1.701*** | (0.082) |
| Ban scenario | 1.000 | (.) | 1.000 | (.) | 1.000 | (.) |
| Approval scenario | 0.208*** | (0.021) | 0.213*** | (0.022) | 3.921** | (1.640) |
| Econ. Priority | | | | | 0.508** | (0.126) |
| Equal priority | | | | | 1.000 | (.) |

¹³ Respondents who said they had previously heard of glyphosate also reported higher levels of concern about pesticides and more precautionary attitudes towards their authorization (discussed below), indicating a potential source of bias relative to the full sample.

| | | | | | | |
|---|----------|---------|----------|---------|----------|---------|
| Env. Priority | | | | | 2.560*** | (0.684) |
| Approval scenario # Econ. priority | | | | | 1.831 | (0.575) |
| Approval scenario # Env. priority | | | | | 0.376*** | (0.104) |
| Pesticide concern | | | | | 1.320** | (0.142) |
| Approval scenario # Pesticide concern | | | | | 0.516*** | (0.060) |
| Precaution preference | | | | | 0.915 | (0.073) |
| Approval scenario # Precaution preference | | | | | 0.839* | (0.071) |
| Political ideology (centered) | 0.932* | (0.033) | 0.930* | (0.034) | 0.968 | (0.038) |
| Approval scenario # Political ideology (centered) | 1.142*** | (0.044) | 1.144*** | (0.044) | 1.068 | (0.044) |
| Age | 0.988*** | (0.002) | 0.987*** | (0.002) | 0.990*** | (0.002) |
| Gender ref. male | 0.764*** | (0.047) | 0.775*** | (0.048) | 0.821** | (0.053) |
| Education level | 0.998 | (0.017) | 0.998 | (0.017) | 1.007 | (0.018) |
| Subjective income | 1.072** | (0.028) | 1.072** | (0.028) | 1.062* | (0.029) |
| Attentiveness | 0.884 | (0.059) | 0.891 | (0.060) | 1.012 | (0.072) |
| Observations | | 4331 | | 4331 | | 4193 |
| Pseudo R-squared | | 0.065 | | 0.075 | | 0.105 |

Note: standard errors in parentheses; country fixed effects suppressed from output

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



As such, respondents are generally more likely to accept the result of a hypothetical authorization decision opposed to their prior expressed preference if it is taken under a procedure they support than if it is taken under a procedure they do not support. As Figure 2 shows, respondents are also more likely to accept the result of a hypothetical authorization decision opposed to their prior expressed preference or to give a “don’t know” opinion than to reject the decision if it is taken under a procedure they strongly support (rating of 5). However, the net levels of decision acceptance are nonetheless different between those who believe that farmers should not be allowed to use pesticides containing glyphosate (presented with the approval scenario) and those who support its use (presented with the ban scenario). As Figure 3 shows, the levels of acceptance, rejection, and indecisiveness are thus asymmetrical between supporters and opponents of glyphosate, confirming hypothesis 3. However, as this figure also shows, the positive effect of a supported decision-making procedure on decision acceptance can be observed among both opponents and supporters of glyphosate.

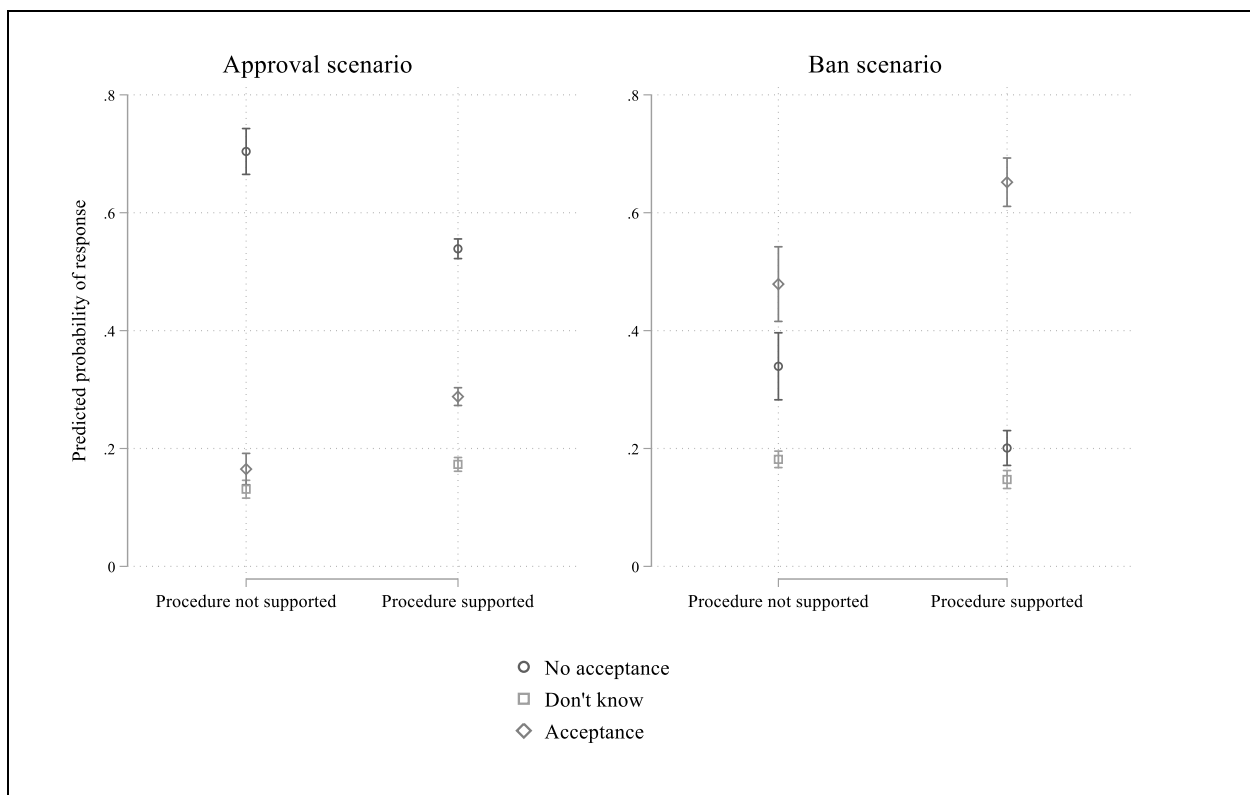


Figure 4. Predicted level of decision acceptance over different decision acceptance experiment scenarios.

Note: graph based on model 1 of table 2.

What explains the asymmetric levels of decision acceptance among supporters and opponents of glyphosate? As discussed above, we expect that respondents’ attitudes toward environmental policies are to a large extent driven by their concern for the environment and their preference

for precaution in regulation. To test hypothesis 4 we operationalized environmental ideology by asking respondents whether they prioritized environmental protection over economic growth, economic growth over environmental protection, or whether they considered both goals as equally important. To test hypothesis 5, we operationalized pesticide concern as an index formed from two items in our survey questionnaire, the first measuring concern about the possible negative effects of pesticides on human health, and the second measuring concern about the possible negative effects of pesticides on the environment. Both are measured on a 5-point scale anchored with different degrees of concern. To test hypothesis 6, we operationalized precautionary preference as the extent to which respondents believe that “The public authorities should approve a pesticide if there is a small but unproven chance that it might have harmful effects”, ranging from 1 (“strongly agree”) to 5 (“strongly disagree”). In order to test their effect, these three variables are interacted with the experiment scenario, similar to the ideology variable as discussed above.

Model 3 in Table 2 shows that prioritizing environmental protection over economic growth, pesticide concern, and precautionary preference decrease the proportional odds of acceptance in the approval scenario, confirming the hypotheses. In addition, for pesticide concern we also see the opposite effect for the ban scenario, where higher levels of pesticide concern are associated with higher levels of acceptance.

Figures 4, 5, and 6 present these results graphically. They show how the predicted level of decision acceptance among opponents of glyphosate declines when respondents prioritize environmental protection above economic growth, when their level of concern about pesticides is higher, and when the intensity of their precautionary preferences is strong. A reverse pattern of higher decision acceptance among supporters of glyphosate exposed to a ban scenario can be observed for higher levels of pesticide concern, while prioritization of environmental protection and levels of precautionary preferences have little impact on decision acceptance among this group.

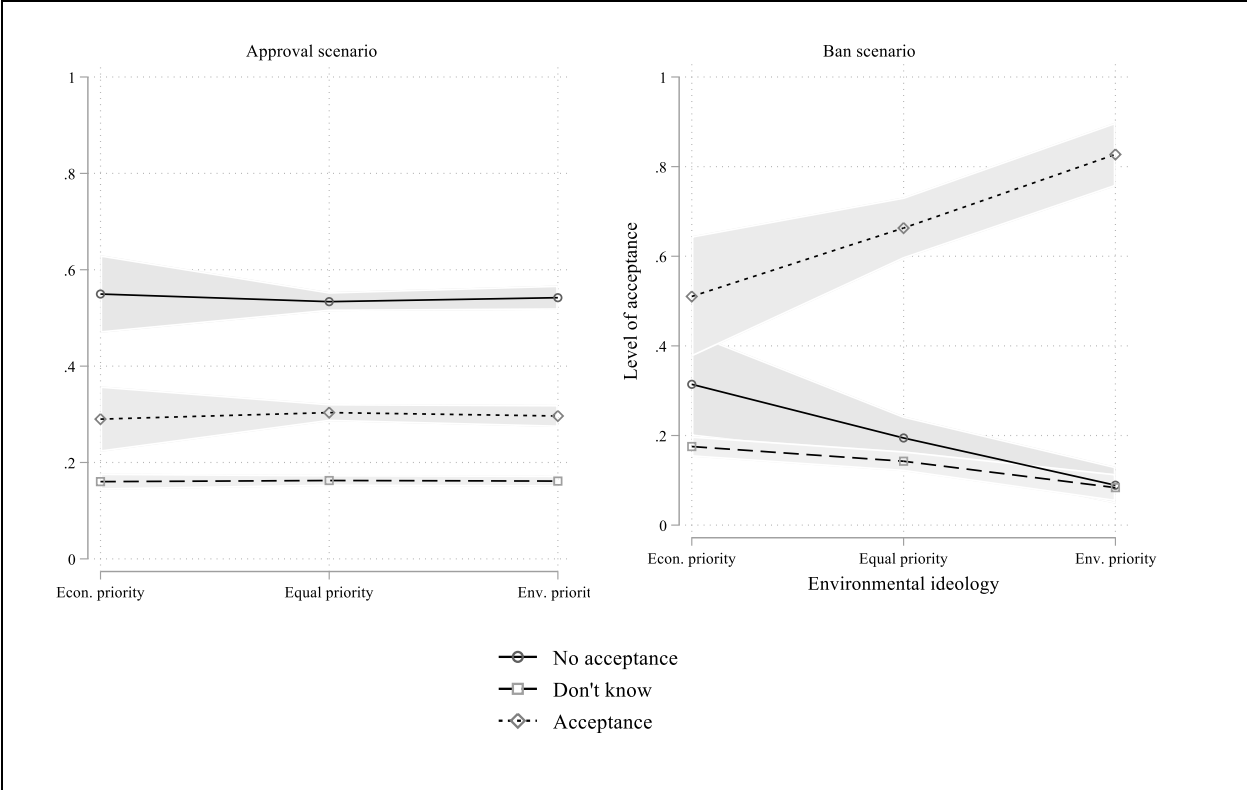


Figure 5. Level of acceptance over environmental ideology by experiment scenario.

Note: Graph based on model 3 of Table 2.

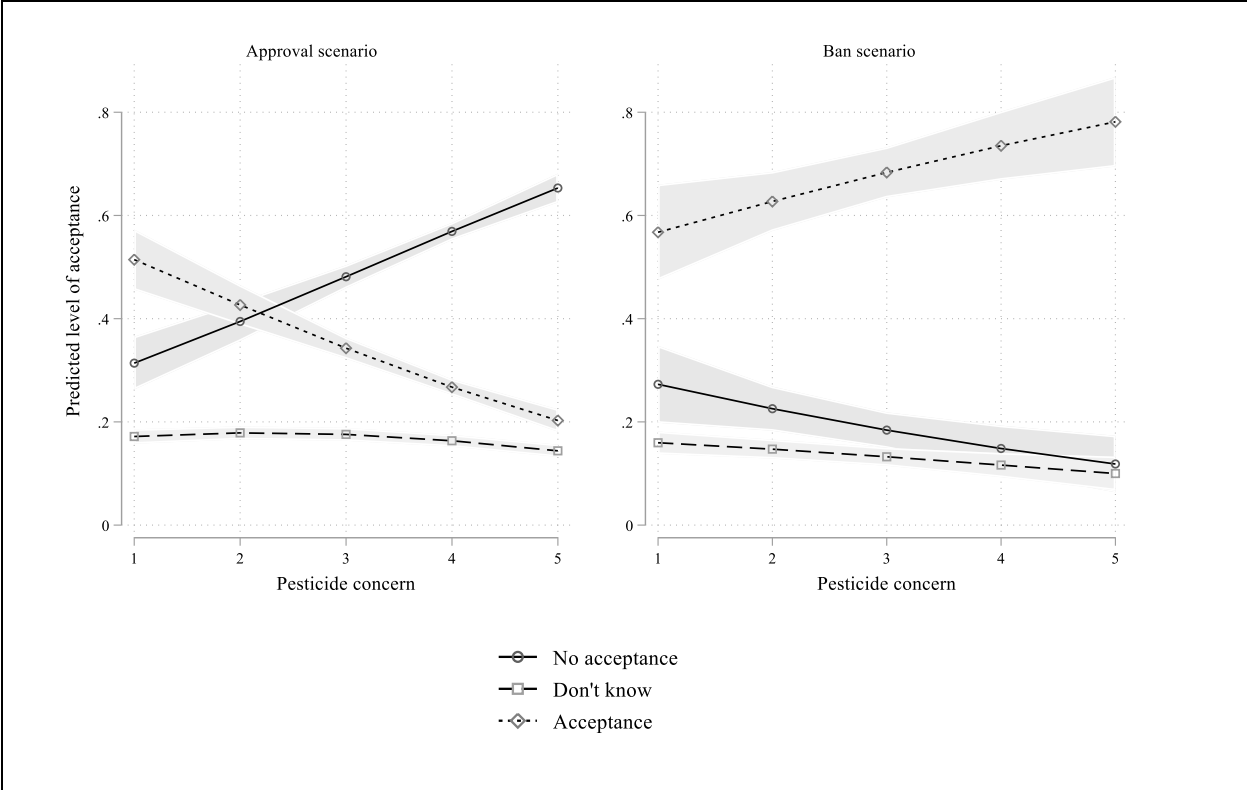


Figure 6. Level of acceptance over pesticide concern by experiment scenario.

Note: Graph based on model 3 of Table 2.

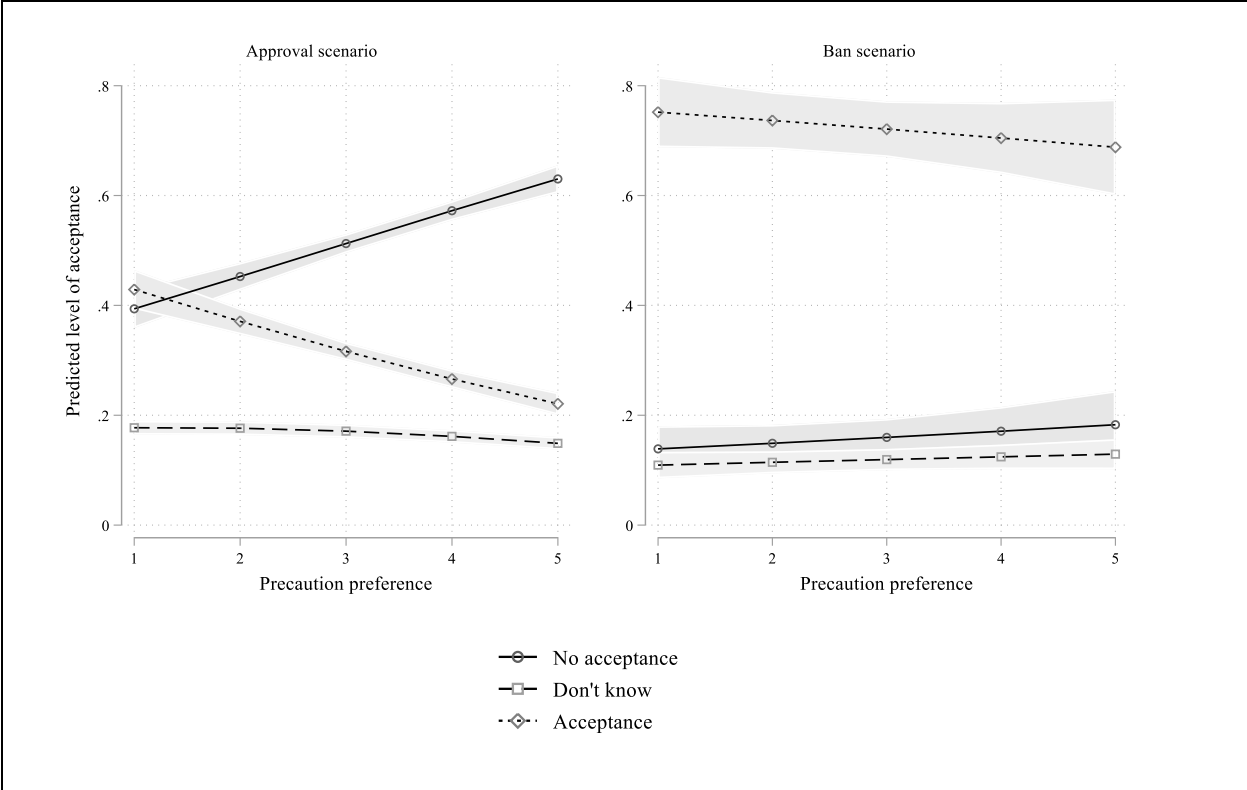


Figure 7. Level of acceptance over precaution by experiment scenario.

Note: Graph based on model 3 of Table 2.

Robustness

Results discussed in the Appendix show that the results presented above are even stronger when excluding respondents who said that they had not heard of glyphosate (Table A.3, 48.8 percent of the sample). Additionally, the results are very similar when including only those who previously did not know whether farmers should be allowed to use glyphosate (Table A.4, 42.7 percent of the sample) or for the full sample (Table A.5). The results of the second experiment do not change in any meaningful way after those who failed the attention check are excluded from the analysis. Lastly, for all models presented in Table 2, the proportional odds assumption was violated for the “support most preferred package” variable and the “rating given to most preferred package” variable, as well as for some of the control variables. However, relaxing the assumption using a generalized ordered logit model does not change the conclusions drawn from the results in any substantive way.

4. Conclusions

Our study provides robust evidence that governance reforms which citizens strongly support can enhance acceptance of regulatory decisions counter to their prior expressed preferences, even

on highly politicized issues such as authorization and use of pesticides. Our findings clearly show that respondents are more than twice as likely to accept a hypothetical authorization decision on glyphosate, a particularly controversial pesticide, if it were taken under a proposed decision-making procedure (compromising a package of options on different dimensions) that they support. This effect becomes progressively stronger as the level of support expressed for the proposed decision-making package rises. These results hold not only for those respondents who expressed a prior opinion on whether farmers should be allowed to use glyphosate, but also for the substantial minority who did not have a clear prior view (and were randomly assigned to approval or ban scenarios), as well as for the sample as a whole. These effects are asymmetrical between ex-ante supporters and opponents of glyphosate. But even among this latter group, an approval decision taken under a procedure they support reduces the probability of opposition substantially.

In extrapolating from these experimental results to potential public reactions to a real-life pesticide authorization decision, such as that on glyphosate, which is currently undergoing a renewal procedure in the EU, it is important to emphasize that respondents' likely willingness to accept regulatory decisions taken under a procedure they support will depend on their *subjective perception* of the extent to which the actual decision-making procedure in question conforms to their preferences. The latter, in turn, is partly a matter of information and communication. Thus, for example, citizens may not be aware that EU regulation already permits the authorities to remove previously approved pesticides from the market if unexpected negative effects are identified, as recently occurred in the case of neonicotinoids, which have been found to be dangerous to bees,¹⁴ or that the effects on organic farmers are sometimes discussed when plant protection products such as copper compounds are approved.¹⁵ But citizens' perceptions of the conformity of an actual decision-making procedure to their preferences may also be influenced by conflicting interpretations of regulatory practice. Thus, for example, the draft report of the Assessment Group on Glyphosate of the European Food Safety Authority states that 7000 public scientific studies were considered alongside the dossier submitted by the applicants, but it does not explain how the results of other relevant studies were weighted in relation to those conducted on behalf of the manufacturers, which have already attracted sharp methodological criticism from NGOs and associated scientists.¹⁶ As with other controversial issues, ranging from GMOs to free trade agreements, citizens' perceptions of how far regulatory decision-procedures in the case of glyphosate renewal match their preferences will be shaped by competitive framing by civil society organizations and other groups, as well as by the arguments and actions of public authorities themselves (Benford & Snow 2000; Chong & Druckman 2007a, 2007b; Borah 2011).

Our results confirm the findings of previous experimental studies that citizens' support for specific features of a decision-making procedure, such as rationale transparency and balanced stakeholder participation, can enhance their acceptance of public decisions (de Fine Licht 2014;

¹⁴ https://ec.europa.eu/food/plants/pesticides/approval-active-substances/renewal-approval/neonicotinoids_en.

¹⁵ Personal communication from Klaus Berend, Head of Unit E.4, Pesticides and Biocides, DG Health and Food Safety, European Commission, 6 August 2021.

¹⁶ AGG (2021: 3-4); HEAL (2021); Corporate Europe Observatory (2021).

de Fine Licht et al. 2014; Porumbescu & Grimmelikhuisen 2018; Beyer & Arras 2021). But compared to previous studies focused on transparency and stakeholder participation, our results show much stronger effects of citizens' support for a regulatory decision-making procedure on acceptance of policy outcomes opposed to their prior substantive preferences, despite the high political salience of the issue (Earle & Sigrist 2008; Essaisson et al. 2016, 2017; Porumbescu & Grimmelikhuisen 2018; Beyers & Arras 2021). While an explanation for these diverging results cannot be definitely provided, it seems plausible to argue that our study finds stronger effects of support for a regulatory decision-making procedure on decision acceptance because the treatment offered in our conjoint experiment is much richer than those in previous experiments and contains policy proposals respondents value more highly, concerning the legitimate factors and sources of evidence to be considered in authorization decisions, together with the arrangements for post-market monitoring and review of such decisions. At the same time, however, it is a limitation of our study that we did not include transparency and stakeholder participation in the conjoint experiment. To test the validity of this conjecture and explore the generalizability of our findings, it would be valuable for future research to conduct similar experimental studies in other policy fields, while including transparency and stakeholder participation among the dimensions of the conjoint design.

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Appendix 1: Supplemental Analyses and Materials

Table A.1. Per-country specification of economy, structure of agricultural sector, agricultural zone membership and EU-membership.

| | GDP in millions of Euro | Real GDP per capita Euro (2020) | Size of agricultural sector (% GDP) | Organic farming percentage (% total farming hectares) | Annual pesticide use per hectare of farmland (kg) | Agricultural zone membership* | EU- membership since |
|-----------------|-------------------------------|--|--|--|--|-------------------------------------|----------------------------|
| The Netherlands | 774,039.00 | 40080 | 3.53 | 3.13 | 10 | Central zone | 1958 |
| Germany | 3,344,370.00 | 34060 | 1.55 | 7.31 | 5.6 | Central zone | 1958 |
| France | 2,353,090.00 | 30480 | 3.17 | 6.27 | 5.1 | Southern zone | 1958 |
| Sweden | 471,207.90 | 42370 | 1.19 | 19.15 | 0.8 | Northern zone | 1995 |
| Italy | 1,765,421.40 | 26640 | 2.96 | 15.54 | 8 | Southern zone | 1958 |
| Poland | 496,360.90 | 12660 | 5.03 | 3.44 | 3.2 | Central zone | 2004 |

Source: Eurostat, own calculations, except for agricultural zone membership, which is derived from Hamlyn, 2018.

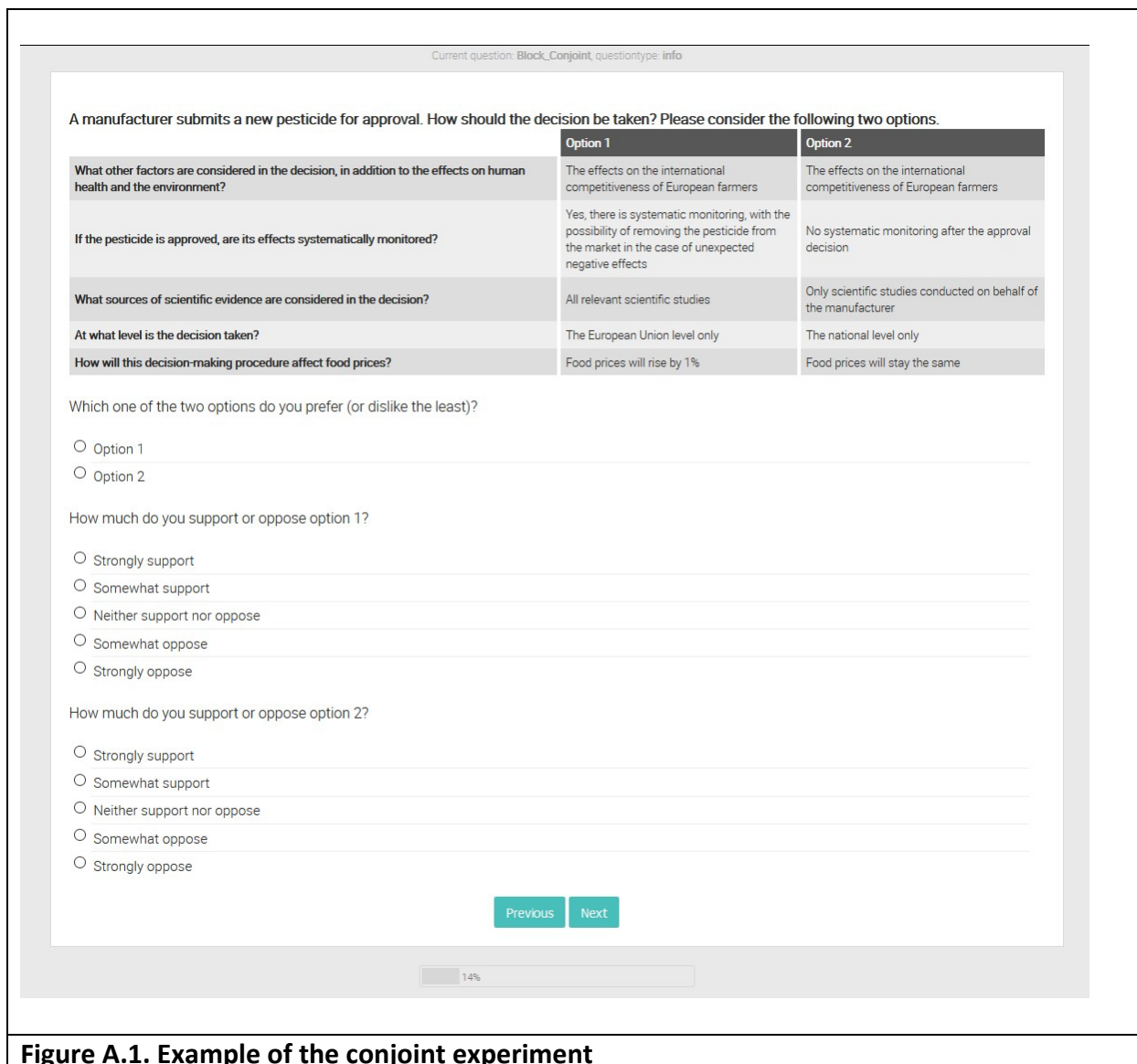


Figure A.1. Example of the conjoint experiment

The control variables included in the analyses presented in the paper are operationalized as follows.

- **Package rating:** “How much do you support or oppose option 1 [2]?” Response categories: Strongly support (5) / Somewhat support (4) / Neither support nor oppose (3) / Somewhat oppose (2) / Strongly oppose (1).
- **Package choice:** “Which one of the two options do you prefer (or dislike the least)?” Response categories: option 1 / option 2. Response categories are recoded to indicate for a single package whether it is chosen (1) or not (0).
- **Proposal support:** Dummy variable indicating 1 when package rating is 4 or higher, and 0 when package rating is 3 or lower.
- **Age:** “Please tell us the month and year of your birth”, resulting in a continuous variable.
- **Gender:** “Are you:”. Response categories: Male (0) / Female (1) / Other (missing) / I prefer

not to say (missing).

- **Education level:** “What is your highest completed level of education? If you are unsure about your degree or if you completed your education abroad, please choose the level you think is closest.” Responses were based on the education levels per country and have subsequently been reclassified according to the International Standard Classification of Education (ISCED), resulting in an ordinal variable ranging from 0 to 8.
- **Income:** “Which of these descriptions comes closest to how you feel about your household's income nowadays?” Response categories: Very difficult on present income and insufficient to cover all the expenses (1) / Difficult on present income (2) / Coping on present income (3) / Living comfortably on present income, but unable to save (4) / Living comfortably on present income and able to save (5) / I prefer not to answer (missing).
- **Glyphosate awareness:** “There has been a lot of controversy recently about glyphosate, a substance widely used in pesticides. Have you heard of glyphosate?” Response categories: Yes (1) / No (0) / Don't know (missing)
- **Glyphosate support / opposition:** “Do you think that farmers should be allowed to use pesticides containing glyphosate?” Response categories: Yes (1) / No (0) / Don't know (missing)
- **Decision acceptance (ban scenario):** Above you can see one of the decision-making procedures you rated most highly. Would you be willing to accept a ban on glyphosate if the decision was based on this procedure? Response categories: No (1) / Don't know (2) / Yes (3).
- **Decision acceptance (approval scenario):** Above you can see one of the decision-making procedures you rated most highly. Would you be willing to accept the approval of glyphosate if the decision was based on this procedure? Response categories: No (1) / Don't know (2) / Yes (3).
- **Political ideology:** “In terms of politics, where would you put yourself on a scale from “left” to “right”?”. Response: Scale from 0 to 10, anchored by “left” (0) and “right” (10) or “don't know” (missing).
- **Attentiveness:** dichotomous variable which is measured on the basis of whether respondents pass an attention check. The question asked for this attention check is as follows: “How important are these issues for you? To ensure that you are still paying attention, we ask that you choose the value 7 for ‘Focus’.”, and subsequently, respondents will be asked to indicate the importance, on a scale from 0 to 10, for “organized crime,” “gay rights,” “taxation,” “national sovereignty” and “focus.” Respondents are considered to have failed the attention check if they choose a different value than 7 for the item “focus.”
- **Environmental ideology:** How important do you think environmental protection is compared to economic growth? Response categories: Environmental protection should take priority even at the cost of economic growth / Environmental protection and economic growth are equally important / Economic growth should take priority even at the cost of environmental protection. Variable included as a categorical variable.
- **Pesticide concern:** an index formed from the following two items (alpha = 0.88):
 - “To what extent are you concerned about possible negative effects of pesticides

on human health?” Response categories: Not concerned at all (1) / Hardly concerned (2) / Somewhat concerned (3) / Very concerned (4) / Extremely concerned (5)

- “To what extent you are concerned about possible negative effects of pesticides on the environment?” Response categories: Not concerned at all (1) / Hardly concerned (2) / Somewhat concerned (3) / Very concerned (4) / Extremely concerned (5)

- **Precautionary preference:** Please say to what extent you agree or disagree with the following statement: “The public authorities should approve a pesticide if there is a small but unproven chance that it might have harmful effects.” Response categories: Strongly agree (1) / Somewhat agree (2) / Neither agree nor disagree (3) / Somewhat disagree (4) / Strongly disagree (5) / Don’t know (missing).

Table A2 shows the results of the conjoint experiment (experiment 1). Model 1 shows the results when regressing on the proposal support variable (being 1 when a proposal is support 4 (“somewhat support) or 5 (“strongly support), being 0 otherwise, and using OLS regression, while model 2 shows the results when regressing on this variable using logistic regression. Model 3 shows the results when using the proposal ranking variable (proposal chosen or not) and using OLS regression, while model 4 shows the results for this dependent variable while using logistic regression.

Table A2. The effect of governance design on support for the pesticide regulation regime

| | Model 1 | | Model 2 | | Model 3 | | Model 4 | |
|-----------------------|----------|---------|----------|---------|----------|---------|----------|---------|
| | B | s.e. | OR | s.e. | B | s.e. | OR | s.e. |
| National level | 1.000 | (.) | 1.000 | (.) | 1.000 | (.) | 1.000 | (.) |
| Combination | 1.063*** | (0.005) | 1.308*** | (0.028) | 1.087*** | (0.006) | 1.456*** | (0.037) |
| EU level | 0.995 | (0.005) | 0.977 | (0.021) | 0.993 | (0.006) | 0.969 | (0.025) |
| No additional factors | 1.000 | (.) | 1.000 | (.) | 1.000 | (.) | 1.000 | (.) |
| Competitiveness | 1.021*** | (0.005) | 1.099*** | (0.023) | 1.036*** | (0.006) | 1.172*** | (0.029) |
| Effects S&O farmers | 1.080*** | (0.005) | 1.402*** | (0.031) | 1.103*** | (0.006) | 1.555*** | (0.040) |
| Only manufacturer | 1.000 | (.) | 1.000 | (.) | 1.000 | (.) | 1.000 | (.) |
| Only independent | 1.163*** | (0.006) | 1.959*** | (0.044) | 1.191*** | (0.007) | 2.181*** | (0.056) |
| All relevant studies | 1.164*** | (0.006) | 1.970*** | (0.045) | 1.201*** | (0.007) | 2.262*** | (0.058) |
| No | 1.000 | (.) | 1.000 | (.) | 1.000 | (.) | 1.000 | (.) |
| Yes | 1.248*** | (0.005) | 2.592*** | (0.051) | 1.286*** | (0.006) | 2.969*** | (0.064) |
| No increase | 1.000 | (.) | 1.000 | (.) | 1.000 | (.) | 1.000 | (.) |
| 1% | 0.971*** | (0.005) | 0.881*** | (0.019) | 0.961*** | (0.005) | 0.838*** | (0.021) |
| 3% | 0.926*** | (0.005) | 0.711*** | (0.016) | 0.897*** | (0.005) | 0.612*** | (0.016) |
| Age | 1.000* | (0.000) | 1.002* | (0.001) | | | | |
| Gender ref. male | 0.982** | (0.005) | 0.923** | (0.023) | | | | |
| Education level | 1.006*** | (0.002) | 1.028*** | (0.007) | | | | |
| Subjective income | 1.001 | (0.002) | 1.004 | (0.011) | | | | |
| Constant | 1.212*** | (0.020) | 0.259*** | (0.019) | 1.264*** | (0.009) | 0.310*** | (0.010) |
| Observations | 51804 | | 51804 | | 54132 | | 54132 | |

| | | | | |
|-----------------------------|-------|----------|-------|----------|
| Adjusted / Pseudo R-squared | 0.088 | 0.067 | 0.115 | 0.087 |
| Estimation method | OLS | Logistic | OLS | Logistic |

Note: standard errors in parentheses; country fixed effects suppressed from output

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

Robustness of the conjoint experiment

The robustness of the results of the conjoint experiment have been tested across a number of alternative specifications of the models. First, we tested whether the results change in any meaningful way if respondents who were inattentive during the survey are excluded. The data allow two ways to check for attentiveness. First, the survey included a dedicated attention check which occurred toward the end of the survey. Excluding respondents who failed this check slightly increases the strength of the dimension effects, which is in line with the expectation that excluding inattentive respondents reduces noise in the analysis. However, the difference in the results is negligible. Second, it was possible for respondents to provide inconsistent answers during the conjoint experiment by choosing one of the two packages but expressing higher support for the non-chosen package. When they did so, they were prompted to revise their answer so that the ranking of policy proposals would be aligned with their ratings. However, we kept track of the number of times that respondents were prompted on their inconsistency. As such inconsistent answers can also be considered to be a sign of inattentiveness, we repeated the analyses after exclusion of respondents who provided one or more inconsistent answers. However, such exclusion does not change the results in any meaningful way.

In addition, we tested robustness across estimation techniques. We investigated whether our results change when the proposal rank variable is used as the dependent variable instead of the proposal support variable; when a random effects model that allows for random intercepts at the levels of the country and the individual is used; when the results are estimated using ordinal logistic regression (using the proposal rating variable); and when the control variables are left out of the model. However, none of these specifications gave results that were meaningfully different from the models presented here in any way.

Robustness of the decision acceptance experiment

We used ordinal logistical regression for ease of interpretation of the results presented in section 3.2 of the paper across the three categories of accept, oppose, and don't know. A Wald test indicates that combining the oppose and don't know categories is not appropriate, meaning that the variables in the model have a different effect on the odds of being in these two categories. Throughout the analyses, the proportional odds assumption of the ordinal logistic regression models was violated for the package support and package rating variables and some of the control variables, but the results did not change significantly when this assumption was relaxed, according to a Brant test. We also conducted the same analyses using multinomial logistic regression, which does not require the proportional odds assumption. This did not change the results in any meaningful way.

Current question: Q17b, questiontype: categorical_sr

| | Option |
|--|--|
| What other factors are considered in the decision, in addition to the effects on human health and the environment? | The effects on small and organic farmers |
| If the pesticide is approved, are its effects systematically monitored? | Yes, there is systematic monitoring, with the possibility of removing the pesticide from the market in the case of unexpected negative effects |
| What sources of scientific evidence are considered in the decision? | All relevant scientific studies |
| At what level is the decision taken? | The national level only |
| How will this decision-making procedure affect food prices? | Food prices will stay the same |

Above you can see one of the decision-making procedures you rated most highly. Would you be willing to accept the approval of glyphosate if the decision was based on this procedure?

Yes
 No
 I don't know

Previous Next

38%

Figure A2. Example of the decision acceptance experiment

The following three tables present the results of the decision acceptance experiment without respondents who had not heard of glyphosate (Table A3), for those who did not express a prior opinion as to whether farmers should be allowed to use it (Table A4) and for the full sample (Table A5).

Table A3. Decision acceptance excluding respondents who haven't heard of glyphosate

| | Model 1 | | Model 2 | | Model 3 | |
|---|----------|---------|----------|---------|----------|---------|
| | OR | s.e. | OR | s.e. | OR | s.e. |
| Support most preferred package | 2.466*** | (0.333) | | | | |
| Rating given to most preferred package | | | 1.785*** | (0.098) | 1.777*** | (0.106) |
| Ban scenario | 1.000 | (.) | 1.000 | (.) | 1.000 | (.) |
| Approval scenario | 0.136*** | (0.018) | 0.137*** | (0.018) | 4.390** | (2.239) |
| Econ. priority | | | | | 0.604 | (0.180) |
| Equal priority | | | | | 1.000 | (.) |
| Env. priority | | | | | 1.987* | (0.612) |
| Approval scenario # Econ. priority | | | | | 1.009 | (0.411) |
| Approval scenario # Env. priority | | | | | 0.468* | (0.150) |
| Pesticide concern | | | | | 1.304* | (0.164) |
| Approval scenario # Pesticide concern | | | | | 0.491*** | (0.068) |
| Precaution preference | | | | | 0.944 | (0.089) |
| Approval scenario # Precaution preference | | | | | 0.771** | (0.078) |
| General ideology (centered) | 0.821*** | (0.038) | 0.810*** | (0.038) | 0.839*** | (0.043) |
| Approval scenario # General ideology (centered) | 1.287*** | (0.064) | 1.305*** | (0.066) | 1.215*** | (0.067) |
| Age | 0.988*** | (0.002) | 0.987*** | (0.002) | 0.989*** | (0.002) |
| Gender ref. male | 0.709*** | (0.052) | 0.719*** | (0.054) | 0.784** | (0.061) |
| Education level | 1.028 | (0.021) | 1.029 | (0.021) | 1.027 | (0.022) |
| Subjective income | 1.079* | (0.034) | 1.080* | (0.034) | 1.065 | (0.036) |
| Attentiveness | 0.818* | (0.068) | 0.833* | (0.070) | 0.912 | (0.081) |
| Observations | | 3214 | | 3214 | | 3128 |
| Pseudo R-squared | | 0.086 | | 0.097 | | 0.132 |

Note: standard errors in parentheses; country fixed effects suppressed from output

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

Table A4. Decision acceptance among those without a clear opinion on glyphosate usage

| | Model 1 | | Model 2 | | Model 3 | |
|---|----------|---------|----------|---------|----------|---------|
| | OR | s.e. | OR | s.e. | OR | s.e. |
| Support most preferred package | 2.618*** | (0.267) | | | | |
| Rating given to most preferred package | | | 1.910*** | (0.103) | 1.904*** | (0.114) |
| Ban scenario | 1.000 | (.) | 1.000 | (.) | 1.000 | (.) |
| Approval scenario | 0.596*** | (0.043) | 0.592*** | (0.043) | 2.508* | (0.919) |
| Econ. priority | | | | | 1.050 | (0.267) |
| Equal priority | | | | | 1.000 | (.) |
| Env. priority | | | | | 1.365* | (0.182) |
| Approval scenario # Econ. priority | | | | | 0.676 | (0.231) |
| Approval scenario # Env. priority | | | | | 0.764 | (0.139) |
| Pesticide concern | | | | | 1.040 | (0.076) |
| Approval scenario # Pesticide concern | | | | | 0.705*** | (0.070) |
| Precaution preference | | | | | 0.956 | (0.048) |
| Approval scenario # Precaution preference | | | | | 0.926 | (0.062) |
| General ideology (centered) | 0.979 | (0.020) | 0.977 | (0.021) | 0.989 | (0.023) |
| Approval scenario # General ideology (centered) | 1.015 | (0.029) | 1.019 | (0.030) | 0.991 | (0.032) |
| Age | 0.993** | (0.002) | 0.993*** | (0.002) | 0.994** | (0.002) |
| Gender ref. male | 0.747*** | (0.054) | 0.760*** | (0.055) | 0.801** | (0.063) |
| Education level | 1.049* | (0.021) | 1.055** | (0.022) | 1.054* | (0.023) |
| Subjective income | 1.050 | (0.033) | 1.055 | (0.033) | 1.057 | (0.035) |
| Attentiveness | 1.287** | (0.103) | 1.320*** | (0.106) | 1.284** | (0.112) |
| Observations | | 2978 | | 2978 | | 2683 |
| Pseudo R-squared | | 0.033 | | 0.044 | | 0.046 |

Note: standard errors in parentheses; country fixed effects suppressed from output

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

Table A5. Decision acceptance among the full sample, including those without a prior clear opinion on glyphosate usage

| | Model 1 | | Model 2 | | Model 3 | |
|---|----------|---------|----------|---------|----------|---------|
| | OR | s.e. | OR | s.e. | OR | s.e. |
| Support most preferred package | 2.063*** | (0.142) | | | | |
| Rating given to most preferred package | | | 1.636*** | (0.053) | 1.717*** | (0.062) |
| Ban scenario | 1.000 | (.) | 1.000 | (.) | 1.000 | (.) |
| Approval scenario | 0.294*** | (0.015) | 0.291*** | (0.015) | 4.939*** | (1.217) |
| Econ. priority | | | | | 0.660* | (0.112) |
| Equal priority | | | | | 1.000 | (.) |
| Env. priority | | | | | 1.465*** | (0.168) |
| Approval scenario # Econ. priority | | | | | 1.216 | (0.272) |
| Approval scenario # Env. priority | | | | | 0.618*** | (0.080) |
| Pesticide concern | | | | | 1.122* | (0.063) |
| Approval scenario # Pesticide concern | | | | | 0.546*** | (0.036) |
| Precaution preference | | | | | 0.919* | (0.037) |
| Approval scenario # Precaution preference | | | | | 0.828*** | (0.039) |
| General ideology (centered) | 0.972 | (0.017) | 0.969 | (0.017) | 0.990 | (0.019) |
| Approval scenario # General ideology (centered) | 1.091*** | (0.022) | 1.096*** | (0.023) | 1.033 | (0.024) |
| Age | 0.989*** | (0.001) | 0.988*** | (0.001) | 0.991*** | (0.001) |
| Gender ref. male | 0.774*** | (0.035) | 0.787*** | (0.036) | 0.844*** | (0.041) |
| Education level | 1.011 | (0.013) | 1.013 | (0.013) | 1.024 | (0.014) |
| Subjective income | 1.059** | (0.021) | 1.061** | (0.021) | 1.049* | (0.022) |
| Attentiveness | 1.033 | (0.052) | 1.050 | (0.053) | 1.122* | (0.060) |
| Observations | | 7309 | | 7309 | | 6876 |
| Pseudo R-squared | | 0.070 | | 0.078 | | 0.110 |

Note: standard errors in parentheses; country fixed effects suppressed from output

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

Acceptance among those who did not express a clear prior opinion on glyphosate usage

In the main body of the paper, we discuss that respondents who did not express a clear prior opinion on glyphosate usage, comprising 42.7 percent of the sample, were excluded from the main analyses. However, these people were also asked to complete the experiment. In their case, they were assigned randomly to either the approval or the ban version of the experiment. It should however be noted that these respondents were not exposed to a hypothetical authorization decision opposed to their prior preference, since they did not express an opinion on glyphosate use by farmers. Here we briefly discuss the levels of decision acceptance among these respondents. Table A6 shows the results of the main model when including these respondents in addition to the rest of the sample and taking into account the scenario to which they were assigned.

Table A6. Decision acceptance among the full sample, specifying scenario assignment among those without a prior clear opinion on glyphosate usage

| | Model 1 | |
|--|----------|---------|
| | OR | s.e. |
| Support most preferred package | 2.213*** | (0.154) |
| Ban scenario | 1.000 | (.) |
| Approval scenario | 0.164*** | (0.017) |
| Don't know assigned to ban scenario | 0.874 | (0.094) |
| Don't know assigned to approval scenario | 0.572*** | (0.061) |
| General ideology (centered) | 0.924* | (0.033) |
| Approval scenario # General ideology (centered) | 1.165*** | (0.045) |
| Don't know assigned to ban scenario # General ideology (centered) | 1.064 | (0.044) |
| Don't know assigned to approval scenario # General ideology (centered) | 1.077 | (0.044) |
| Age | 0.990*** | (0.001) |
| Gender ref. male | 0.758*** | (0.035) |
| Education level | 1.016 | (0.013) |
| Subjective income | 1.061** | (0.021) |
| Attentiveness | 1.003 | (0.051) |
| Observations | | 7309 |
| Pseudo R-squared | | 0.098 |

Note: standard errors in parentheses; country fixed effects suppressed from output

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

Figure A3 shows the predicted probabilities of acceptance among these respondents on the basis of the model presented in table A6. These respondents had a 50 percent probability of decision acceptance under an approval scenario and a 60 percent probability of acceptance under a ban scenario. The extent to which those without a clear opinion on glyphosate are likely to accept an authorization decision taken under a decision-making procedure that they support is thus substantially higher than among those who did express a clear opinion on glyphosate.

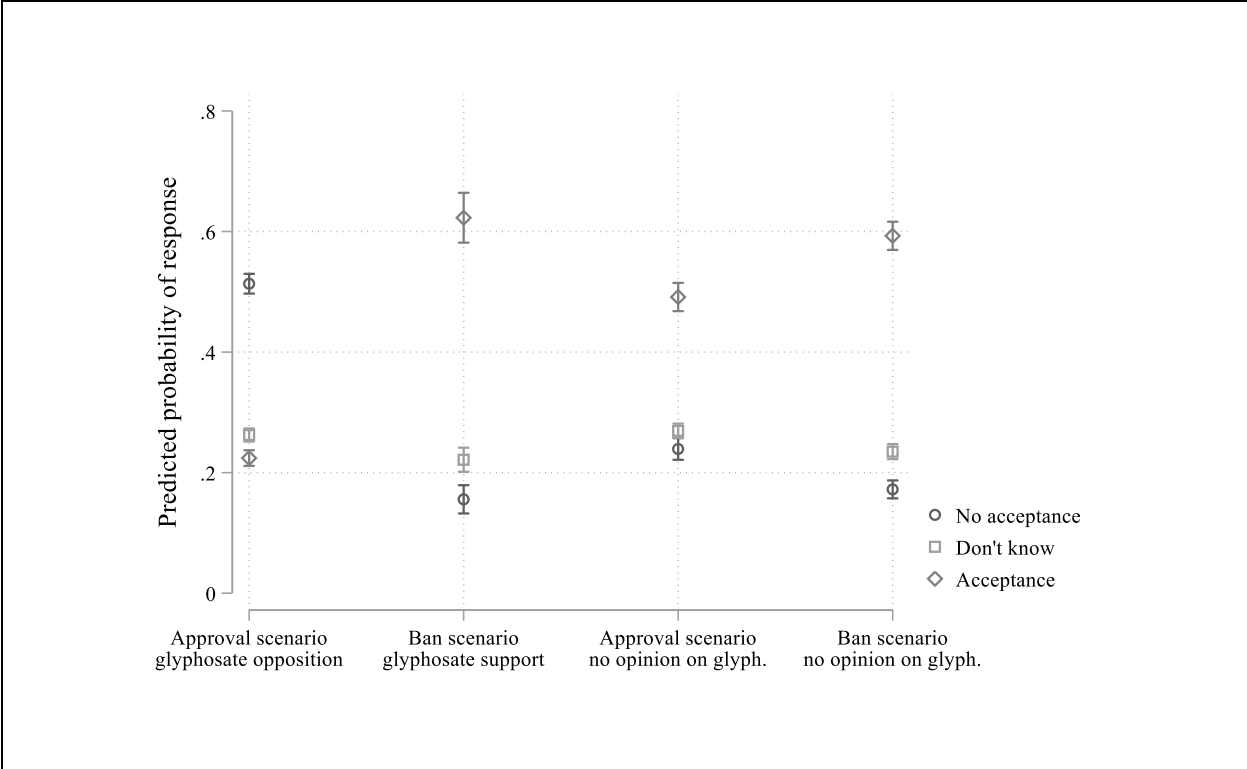


Figure A3. Predicted level of decision acceptance over different decision acceptance experiment scenarios.

Note: Graph based on model 1 of table A6.