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Bridging the gap: the influence of information and education on acceptance of environmental taxes in Switzerland

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Abstract

Mitigating climate change remains a challenge for politics since efficient instruments such as environmental taxes are widely unpopular, with one determinant of objection being a lack of knowledge. Trying to increase environmental tax acceptance, previous studies found positive, negative as well as no effects of information treatments about environmental taxes. Contributing to this inconclusive research, I apply MOSAiCH 2020 panel data from Switzerland, calculating the causal effect of receiving an environmental tax information treatment on willingness to pay them. While the information effect was inconsistent for the full sample, information significantly increases green tax acceptance of less educated people. This subgroup effect hence offers an explanation for previous inconsistencies by showing that information does not affect everyone equally. Especially for less educated people, receiving information about the functioning of environmental taxes might therefore prove crucial for policymakers to gain majority support of environmental taxes necessary for their implementation.

1. Introduction

Climate change is progressing rapidly and its consequences are starting to impact earthly life both more frequently and more visibly. Tackling global warming has proven to be challenging in the past, as it is costly and therefore unpopular for governments to implement accurate measures to reduce greenhouse gases. In the context of environmental policymaking, one of the most efficient ways to steer behaviour and to address climate change is by implementing environmental taxes[1] (e.g. Goulder 1995, Fremstad *et al* 2022, Rafique *et al* 2022). Introducing such taxes however usually leads to massive public resistance: As green taxes attach a price to polluting activities, this leads to the internalisation of previously externalised costs (e.g. environmental pollution), so the taxed goods get more expensive. This price increase should, economically speaking, intuitively discourage consumers from purchasing them. Also, like most push-measures, i.e. instruments penalising unwanted behaviour (Steg *et al* 2006), it has been argued that green taxes are widely unpopular because, amongst other reasons, most people do not understand the concept of redistributing tax revenues and only perceive the extra costs generated (e.g. Steg *et al* 2006, Jagers and Hammar 2009, Carattini *et al* 2017, Bachus *et al* 2019, Umit and Schaffer 2020, Hammerle *et al* 2021). One of the main challenges that politicians therefore face is showing citizens that acting environmentally friendly does not always go hand in hand with higher costs and on the contrary, green tax redistribution even has the potential to decrease inequality and poverty, therefore bringing most benefits to those who especially fear price increases due to such taxes (Budolfson *et al* 2021). The question that climate and political scientists have been answering so far was to identify the factors leading to low support of climate change measures that are limiting attempts at reducing the carbon footprint. Despite knowing what causes resistance to environmental taxes, politically and scientifically, there is still no consensus on how these taxes could be made more socially accepted.

[1] The terms 'environmental taxes' and 'green taxes' are used synonymously.

Amongst other determinants, past studies found that a lack of knowledge was one of the main causes for low environmental tax acceptance (Sturgis and Allum 2005, Leiserowitz *et al* 2021) and that accordingly, information has the potential to improve support of environmental taxes (e.g. Feldman and Hart 2018). Following Robert Dahl's (1989) enlightened understanding of democracy, such a lack of information becomes problematic whenever people would change their opinion if presented with more information. Consequently, providing citizens with sufficient and comprehensible information is necessary for them to effectively participate in public debates (Sturgis and Allum 2005). Or as Ajzen *et al* (2011, p. 101) put it: 'A well-informed citizenry is the essential backbone of a free society, and few would dispute the value of more and better information.' Hence, communication is essential in informing people about climate change and possible measures to mitigate it in order for people to decide whether and what measures to introduce, one of them being environmental taxes (Rowan *et al* 2021).

Information could certainly be a way to increase knowledge about and support of environmental taxes, however, existing research remains highly inconclusive. Apart from positive information effects (e.g. Heres *et al* 2017, Fremstad *et al* 2022), negative (e.g. Carattini *et al* 2017, Stadelmann-Steffen 2019) as well as non-significant findings (e.g. Kallbekken *et al* 2011, Bernauer and McGrath 2016) have been identified, too. One reason for these previous inconsistencies could be owed to subgroup effects, meaning that the information effect varies across different population subgroups. For example, differently educated people could be more or less receptive to information about environmental taxes, which is a cognitively rather complex issue. Accordingly, past research has shown that education itself relates positively to green tax acceptance (Bachus *et al* 2019), which inevitably leads to a gap in green tax acceptance between different education groups. Getting approval of less educated voters might hence be crucial to gain majority support of green tax proposals and information might be key in changing less educated citizens' opinion on them. Hence, identifying potential group differences is fundamental in order for governments to carry out information campaigns more efficiently by catering more precisely to specific group needs (Bareinz and Uebelmesser 2020).

To sum up, due to their pricing mechanism, environmental taxes are a highly efficient policy instrument to tackle decarbonisation and therefore the global problem of climate change, yet actual implementation of green taxes remains sparse. As of June 2023, and independent of potential emissions trading systems, only 27 countries worldwide have implemented national-level carbon taxes[2] (The World Bank 2023a). Distributing information on these taxes has the potential to improve green tax acceptance, possibly even for population groups who previously rejected them, such as less educated people, thus in the best case generating the majority support necessary for more widespread implementation of green taxes. Accordingly, my research question can be stated as follows: *Can information about environmental taxes change citizens' willingness to pay them and does this information effect vary across different education groups?*

This research question is tested in Switzerland. While regime type itself does not seem to correlate with a country's environmental policy ambitiousness per se (see Kammerlander and Schulze 2021), due to Switzerland's high degree of direct democracy and its concomitant voter veto power, testing the above-mentioned research question in this setting particularly makes sense. In 2020, Switzerland collected 10 billion CHF in environmental tax revenue (1990: 5bn CHF), so green taxes are not completely new to Swiss residents (FSO, Federal Statistical Office 2022a). Still, with Switzerland also needing to adhere to the 2015 Paris Agreement goals and having to introduce additional decarbonisation policies, expanding environmental taxation is crucial. Due to the country's high degree of direct democracy, further green taxation however depends on citizens' willingness to support such measures at the ballot, where costly policies like (environmental) taxes are often rejected. One prominent example is the Swiss CO2-law from June 2021, which, amongst other policy instruments, wanted to introduce a tax on carbon emissions and therefore probably did not gain majority support in the vote. Hence, whereas taxes in other democratic countries can be imposed without voters' explicit approval, giving them a chance to experience taxes and adapt their opinions on them, in Switzerland, citizens first have to be convinced about a tax' benefits before policymakers can actually implement them. In order to gain broad support of unpopular but cost-efficient measures such as environmental taxes, it is therefore of utmost importance for voters to comprehend how environmental taxes work and how their revenue is used. Findings from Switzerland could, one, also be used to make climate change measures more palatable in other countries, and two, be applied to different policy contexts.

The contribution is as follows: Cross-sectional research on the influence of information and acceptance has been conducted in many fields of (environmental and political) science, still, there does not seem to exist a

[2] There are two main forms of carbon pricing: Carbon taxes and emissions trading systems (ETS). In general, carbon pricing is a measure intended to capture the external costs of greenhouse gas emissions. These costs are internalised by attaching a price to the source, usually a price on CO_2. This holds those responsible for the emissions accountable and incentivises them to emit less CO_2. Carbon taxes put a fixed price on a unit of emitted CO_2. Here, the emission reduction outcome is not pre-defined. Emissions trading systems however set this target a priori. ETS create a market where emissions units are traded according to demand and supply, so the price remains flexible (The World Bank 2023b).

systematic longitudinal analysis on one of the most efficient tools to combat climate change, namely environmental taxes. While a lot is known about the personal and contextual determinants of environmental tax acceptance and their societal unpopularity, barely any research about how information about said taxes can *change* people's willingness to pay them exists. This study, analysing the two-wave MOSAiCH 2020 dataset, treats citizens with neutral information as opposed to politically-ideologically charged information treatments, as has been done in most previous studies (e.g. Kahan 2010). Hence, it could be considered a 'most likely'-case for information effects. In accordance with existing studies, I only find an inconsistent information effect for the full sample across different models. One possible explanation for this inconsistency could lie in heterogeneous or even diverging subgroup effects. Hence, I investigate the possibility of an education moderation effect, which has not been examined previously either. With results showing a positive information effect only for less educated citizens, this non-universality offers an explanation for the inconsistent information effects found in the past, pointing to the need to hereafter differentiate information effects between population subgroups. The results also give valuable insights into how policymakers especially in (direct-)democratic countries can distribute information about environmental taxes in order to make them more comprehensible and therefore more popular and implement them to tackle climate change more efficiently. Specifically, stating and explaining the functioning and use of taxes seems to bridge the gap between different education groups regarding acceptance of environmental taxes.

2. Theoretical background

2.1. Controversy around environmental taxes

As mentioned, (environmental) taxes are as unpopular as they are controversial, emphasising the need to look more closely at the reasons behind this. In general, taxes have three functions: First, taxes generate revenue, which allows governments to finance public goods. The second goal is redistribution in order to decrease inequality. And third, consumption taxes always regulate behaviour (Avi-Yonah 2006). Environmental taxes primarily address this third goal, as described by Albrecht (2006, p. 88): 'Environmental taxes penalise the production and consumption of 'bads' while generating revenues that can offset existing taxes on 'goods' like labour. Higher prices for energy, wastes and environmental damages provide clear incentives for consumers and producers to search for technologies that can minimise or eliminate the environmental penalties'. Taxing the externality-generating behaviour should incentivise behavioural change since higher prices mean less consumption and hence, less emissions (Jagers and Hammar 2009), therefore 'getting the price right' (Goulder 1995, p. 157). One example deemed to drive decarbonisation is the Swiss CO2-tax, which is collected on all fossil thermal fuels and therefore incentivises the use of more carbon-neutral energy sources (FOEN, Federal Office for the Environment 2021). Empirically, it has in fact been shown that countries employing environmental taxes have, both short- and long-term, smaller ecological footprints (Rafique *et al* 2022), alluding to both their economic and ecological efficiency.

However, despite the need to fulfil the 2015 Paris Agreement goals and to reduce carbon emissions, environmental taxes are still underused as they are met with broad rejection (e.g. Umit and Schaffer 2020). People prefer softer policy measures such as information campaigns (Douenne and Fabre 2020) or subsidies over hard policy instruments like taxes when dealing with environmental problems (Heres *et al* 2017; but see also Banerjee *et al* 2021). The following reasons explaining green tax unpopularity have been proposed: One, it stems from the economic logic that, like all taxes, they decrease individual budget (Jagers and Hammar 2009)[3] and are often perceived as an infringement on freedom of choice (Kim *et al* 2013), as coercive (Bachus *et al* 2019) and unfair (Jagers and Hammar 2009), e.g. for residents from rural areas (Ewald *et al* 2021). Fear of negative impacts on low-income households is also a factor which leads to the rejection of green taxes (Carattini *et al* 2018, Fremstad and Paul 2019). Another issue is that people tend to believe that Pigouvian taxes are not effective (Baranzini *et al* 2014) because they have trouble understanding taxes in general (Ewald *et al* 2021) or seeing the true costs and benefits specifically (Steg *et al* 2006). People fear that governments only want to increase fiscal revenue and that environmental taxes do not discourage climate-harming behaviours after all (Carattini *et al* 2018). Also, the more visible taxes are, the more adverse people react to them, which, by mischance, is the case for most environmental taxes (Bachus *et al* 2019). And further, as initially mentioned, low science literacy and a lack of understanding about how environmental taxes work also account for insufficiently high levels of green tax acceptance (e.g. Sturgis and Allum 2005, Leiserowitz *et al* 2021).

[3] This assumption is not undisputed: Kallbekken and Saelen (2011) found that, in Norway, it is not economic self-interest that makes environmental taxes unpopular but rather beliefs about environmental consequences that determine whether people are in favour or against environmental taxes.

2.2. Information and acceptance of environmental taxes

Hence, one way to possibly change acceptance of environmental taxes is by exposing citizens to more information on them. It is a commonly spread belief that new knowledge changes attitudes or behaviours (Marteau *et al* 2008). Although widely criticised for being too simplistic (Nisbet and Scheufele 2009), the knowledge or information deficit model could help to theoretically explain the association between people's amount of information (and in the best case, therefore, knowledge) on environmental taxes and their support of said taxes. Despite the criticism, the model still persists today since, and amongst other factors, it works well for policy design and offers a narrow framework (Stoutenborough and Vedlitz 2014, Bidwell 2016).

In the information deficit model, two beliefs are inherent: First, public scepticism towards science is caused by a lack of scientific knowledge. Public ignorance and science illiteracy are the main problems for a lack of acceptance of a multitude of scientific issues (Nisbet and Scheufele 2009, Rowan *et al* 2021) because then, 'people fall back on mystic beliefs and irrational fears of the unknown' (Sturgis and Allum 2005, p. 57). And the second model assumption states that this lack of knowledge can be overcome by experts providing additional and more comprehensible information to lay people (Nisbet and Scheufele 2009, Rowan *et al* 2021).

Existing research on the topic remains inconclusive and appears to be highly context-dependent. In line with the information deficit model, researchers from various scientific disciplines have empirically proven that receiving information or having more knowledge leads to higher acceptance, support or willingness to pay of whatever the information tries to convey. For example, broadly testing the influence of scientific knowledge on attitudes towards science, Bak (2001) as well as Sturgis and Allum (2005) found positive and significant relationships. Or more concretely, Abunyewah *et al* (2020) show that the provision of disaster risk information indeed leads to better disaster preparedness of citizens. The same goes for receiving energy efficiency information and higher willingness to pay more for eco-friendly apartments (Carroll *et al* 2016), information on pesticides and higher willingness to pay for organic food (McFadden and Huffman 2017), information on water consumption and people's water saving behaviour (Céspedes Restrepo and Morales-Pinzón 2020) or information on alternative fuels and their social acceptance (Offermann-van Heek *et al* 2020). Regarding renewable energy acceptance, being more knowledgeable on the topic (Guo *et al* 2014, Stoutenborough and Vedlitz 2014, Han *et al* 2020, Hojnik *et al* 2021) or receiving positive information about solar panels (Bekker *et al* 2017) and other renewable forms of electricity (Bidwell 2016, Dubois *et al* 2019) was proven to enhance people's opinions on them.

Regarding income tax acceptance, possessing more tax knowledge seems to increase willingness to pay them (Ali and Nasaruddin 2020). Focussing specifically on environmental tax acceptance, there also exists evidence suggesting a positive relationship between either information (Brouwer *et al* 2008, Jagers and Hammar 2009, García-Maroto *et al* 2015, Heres *et al* 2017, Feldman and Hart 2018) or knowledge (Weinstein Agrawal *et al* 2010, Douenne and Fabre 2020) and support for (paying) environmental taxes. Furthermore, acceptance of environmental taxes seems to be especially high when their revenue is explicitly earmarked for environmental purposes (Baranzini *et al* 2014, Baranzini and Carattini 2017, Carattini *et al* 2017), for income redistribution (Gevrek and Uyduranoglu 2015), for the mitigation of environmental impacts due to climate change or the financing of renewable energy projects (Rotaris and Danielis 2019) or climate projects (Maestre-Andrés *et al* 2021). Informing people simultaneously about the real costs of different instruments such as taxes and subsidies also seems to be conducive to green tax acceptance (Jagers and Hammar 2009). Additionally, research has shown that, in the absence of political messaging, information about carbon pricing and tax rebates has a positive effect on public support (Fremstad *et al* 2022, Zumofen *et al* 2023). In summary, by giving people information about how environmental taxes work, what their purpose is and that refrains from using political-ideological messaging, acceptance of green taxes could be increased. Since I focus on a balanced information treatment, i.e. one that lists scientific facts in an apolitical manner, building upon these previous findings as well as the information deficit model, the first hypothesis can therefore be summarised as follows:

H_1: *Information about environmental taxes increases acceptance of these taxes.*

2.3. Information effects, environmental taxes and education

Apart from this positive information effect and as mentioned earlier, research has also identified negative (e.g. Carattini *et al* 2017, Stadelmann-Steffen 2019) as well as insignificant (e.g. Kallbekken *et al* 2011, Bernauer and McGrath 2016) information effects. One explanation for these previously inconclusive findings on information effects could be due to its non-universality. The posited information effect might not persist throughout the full sample and could vary across different population groups, such as unequally educated people. So far, research has not sufficiently considered this possibility of interaction effects with information treatments, neither for education nor other factors. Arguing along the lines of the information deficit model again, since a lack of knowledge is expected to negatively correlate with acceptance of scientific issues or technologies due to

unfamiliarity (e.g. Qu *et al* 2011, Bekker *et al* 2017), it seems plausible that these information effects vary across education groups. As people with higher formal education should have acquired more knowledge about scientific topics already (e.g. Hoffmann and Muttarak 2017), due to the logic of marginal utility, providing additional information on how environmental taxes work might bring more benefit to less educated people (e.g. Kahan *et al* 2012, Zhou and Dai 2020). Accordingly, the next hypothesis reads as follows:

H_2: *The information effect of environmental taxes is stronger for less educated people.*

On the other hand, acquiring more information about environmental taxes could also be more conducive to green tax acceptance for those with higher education than it is for those with lower educational attainments. As this would widen the knowledge gap instead of narrowing it, more instead of less inequality between the different education groups would be the consequence. This unintended 'Matthew effect', i.e. 'the fact that advantage begets further advantage' (Perc 2014), would hence polarise society even more (see Gustafson and Rice 2016). Such effects have been observed in past information experiments (Sturgis *et al* 2010). Since education on its own relates positively to general scientific attitudes (Bak 2001) as well as disaster preparedness (Hoffmann and Muttarak 2017), environmental support (Ehret *et al* 2017), acceptance of renewable energies (Qu *et al* 2011, Ntanos *et al* 2018, Han *et al* 2020) and even paying environmental taxes (Baranzini and Carattini 2017, Bachus *et al* 2019, Ewald *et al* 2021, Goh and Matthew 2021) as well as due to them having better intellectual processing abilities (Parisi *et al* 2012), giving more information on environmental taxes could result in a weaker information effect for less educated people. The counterhypothesis to H_2 can thus be summarised as:

H_3: *The information effect of environmental taxes is weaker for less educated people.*

3. Research design

3.1. Sample

The research question is studied in Switzerland. As mentioned earlier, Switzerland is highly direct-democratic and frequently votes on ballot proposals, i.a. on environmental issues such as green taxes. In this aspect, Switzerland already has some experience (e.g. taxes on emissions, energy or transportation (FSO, Federal Statistical Office 2022a)) but, like in most countries, they are insufficient to reach the Paris Agreement goals. Due to their ideological connotation and perceived economic burden, these ballot proposals are usually controversial and often rejected, such as the CO2 Act in 2021, which aimed at an encompassing expansion of the Swiss 'cap and dividend'-system to further decrease greenhouse gas emissions (FSO, Federal Statistical Office 2021). Hence, gaining popular support is especially critical in this country to implement more measures such as green taxes to effectively tackle climate change.

In order to test the hypotheses outlined above, the 'Measurement and Observation of Social Attitudes in Switzerland (MOSAiCH) 2020' dataset from Staehli *et al* (2021a) is employed. This two-wave web-based survey was conducted from February to July 2020[4] and consists of a randomly selected sample of 1'155 adults who participated in both waves. On average, the time between the two waves amounted to 65.43 days. All respondents live in Switzerland. In accordance with the ISSP 2020 module on environment, the first wave primarily asked respondents about their environmental attitudes as well as sociodemographic characteristics. In the second wave, more than 70% of the respondents from the first wave participated once more, i.a. partaking in an experiment about environmental taxes (Staehli *et al* 2021b). As table 1 illustrates, the panel sample is virtually identical to the full sample regarding respondents' characteristics, indicating that panel attrition does not happen systematically. Compared to the Swiss population, the MOSAiCH data slightly overrepresent males, those from higher income groups and with higher vocational education as well as voters from the GLP, GPS and SP. Also, people with secondary education or less, university graduates and SVP-voters are somewhat underrepresented in the sample. To exclude potential confounding between educational attainment and party choice, which are typically highly interrelated, correlation analysis has been carried out. With a Pearson correlation index of 0.147, pointing at a negligibly small relationship between higher education and voting for a more leftist party, this concern can be allayed. Appendix A further shows the political-ideological composition for all education groups.

Data sources: FSO, Federal Statistical Office (2019), FSO, Federal Statistical Office (2022b), FSO, Federal Statistical Office (2022c), FSO, Federal Statistical Office (2022d), Staehli *et al* (2021a) (own calculations).

[4] The invitation to take part in the second wave was received by the end of April 2020. All respondents who completed at least 50% of the first questionnaire by 20 April 2020 were invited again (Staehli *et al* 2021b).

Table 1. Sample and population descriptives.

Variable	Full sample	Panel sample	Switzerland
Age	19-64 years: 76.88%	19-64 years: 77.98%	20-64 years: 76.69%
	65 years+: 23.12%	65 years+: 22.02%	65 years+: 23.31%
Gender	Male: 51.06%	Male: 54.16%	Male: 49.6%
	Female: 48.94%	Female: 45.84%	Female: 50.4%
Party strength	SVP: 19.64%	SVP: 18.43%	SVP: 25.6%
	BDP: 2.31%	BDP: 2.84%	BDP: 2.4%
	FDP: 16.35%	FDP: 16.04%	FDP: 15.1%
	CVP: 9.65%	CVP: 10.13%	CVP: 11.4%
	GLP: 11.66%	GLP: 13.20%	GLP: 7.8%
	EVP: 1.84%	EVP: 1.82%	EVP: 2.1%
	GPS: 17.83%	GPS: 17.29%	GPS: 13.2%
	SP: 20.71%	SP: 20.25%	SP: 16.8%
Income	<3'300 CHF: 9.18%	<3'300 CHF: 5.69%	Max. 3'000 CHF: 21%
	3'300-4'299 CHF: 8.35%	3'300-4'299 CHF: 5.88%	3'001-4'000 CHF: 11.3%
	4'300-5'299 CHF: 10.56%	4'300-5'299 CHF: 10.06%	4'001-5'000 CHF: 17.2%
	5'300-6'399 CHF: 10.34%	5'300-6'399 CHF: 10.34%	5'001-6'000 CHF: 16.3%
	6'400-7'499 CHF: 9.93%	6'400-7'499 CHF: 11.48%	6'001-7'000 CHF: 11.3%
	7'500-8'799 CHF: 12.03%	7'500-8'799 CHF: 12.90%	7'001-9'000 CHF: 11.6%
	8'800-10'299 CHF: 12.94%	8'800-10'299 CHF: 13.38%	9'001-10'000 CHF: 3.2%
	10'300-12'199 CHF: 10.87%	10'300-12'199 CHF: 12.81%	10'001-12'000 CHF: 3.5%
	12'200-15'599 CHF: 8.82%	12'200-15'599 CHF: 9.30%	12'001-15'000 CHF: 2.1%
	Min. 15'600 CHF: 6.99%	Min. 15'600 CHF: 8.16%	Min. 15'001 CHF: 2%
Education	Mandatory: 12.36%	Mandatory: 10.46%	Mandatory: 11%
	Secondary: 37.52%	Secondary: 33.56%	Secondary: 44.6%
	Higher vocational: 32.29%	Higher vocational: 34.1%	Higher vocational: 14.8%
	University: 17.83%	University: 21.88%	University: 29.6%

Note: The coding of some variables in this table does not correspond to the variable coding in the analyses. To make the MOSAiCH data as comparable as possible to official data from Switzerland, they were (to some degree and only in the context of this table) recoded accordingly in order to check for representativeness. However, especially the variables of income and education were measured significantly differently, therefore, these comparisons should only be seen as proxies.

3.2. Variables

Within the scope of the experiment, the following information treatment was randomly assigned to 50% of the sample at the beginning of the second wave:

> *With environmental taxes, we want to influence people's behaviour. When electricity is taxed, the price of electricity goes up. As a result, we consume less energy because it costs more. The tax on electricity allows the state to receive money. For example, it can use that money to promote renewable energy, such as hydro, solar and wind power. Some scientists say that it is a good thing that money from an electricity tax is redistributed to the population: 'People are rewarded for using less electricity. And it doesn't cost the government anything.'*

Consequently, the independent variable consists of this information dummy where 0 denotes that the person has not received the information about environmental taxes and 1 denotes that the person has received said information. As Nisbet and Scheufele (2009) suggested, this statement abstains from using partisan info or words such as 'climate change', therefore, this kind of framing might appeal to more people. It can be classified as a balanced information treatment, since the information given is stated in a neutral manner but still stresses certain scientific facts (see Xafis *et al* 2015). Also, clearly mentioning the benefit of population redistribution (Budolfson *et al* 2021) as well as earmarking the revenue for environmental purposes, thus emphasising the costs and (often overlooked) benefits, might prove essential to gain societal support (e.g. Baranzini *et al* 2014). This item therefore combines multiple findings of previous studies by both earmarking the tax' environmental benefit and comprehensibly explaining its functioning.

The moderator variable, which measured a respondent's highest educational attainment, was coded as follows: 'secondary education or less', 'higher vocational education', 'university degree'.

Due to the panel structure of the dataset, the dependent variable was collected twice, once per wave. The corresponding item asked respondents both times '*How willing would you be to pay much higher taxes in order to protect the environment?*' and was coded to range from −2 'very unwilling', −1 'fairly unwilling', 0 'neither willing nor unwilling', 1 'fairly willing' up to 2 'very willing'. In the second wave, this item was not immediately

asked after the information treatment, which reduces the risk of a social desirability bias. The wording of this item asks for 'willingness to pay', which can be seen as an indirect measure of support for policy instruments such as taxation[5] (Bachus *et al* 2019). The strong wording of the item was chosen on purpose as to only capture willingness to pay green taxes of people who definitely agree with this measure (Staehli *et al* 2021b).

The codebook including all variables used can be found in appendix B.

3.3. Methods

Following the logic of the difference-in-differences approach (see Wooldridge 2016), a mean comparison is first presented. Then, to analyse the causal effect of the information treatment on acceptance of environmental taxes in more detail, a fixed-effects model with robust standard errors is estimated. Since fixed-effects models cannot include any time-constant covariates, no further control variables are added in the main model[6] (see Angrist and Pischke 2009, Wooldridge 2016). However, as a robustness check, the dependent variable will also be modelled as the change in willingness to pay higher environmental taxes between the two points in time and analysed in a linear regression model, which also includes control variables. Formally, the fixed-effects model (where Y_{it} stands for the dependent variable of willingness to pay higher green taxes, β_1 for the constant, $\beta_2 \times I_{it}$ for the information effect, δ_t for the time effect, α_i for all time-invariant variables and ε_{it} is the error term) can be summarised as:

$$Y_{it} = \beta_1 + (\beta_2 \times I_{it}) + \delta_t + \alpha_i + \varepsilon_{it}$$

To answer the second part of the research question, the information treatment variable is interacted with the highest level of a respondent's education. This moderation effect was then also regressed on acceptance of environmental taxes in a fixed-effects model with robust standard errors as well as in a model including the dependent variable as the change in willingness to pay higher environmental taxes.

This fixed-effects model including the interaction effect between the information treatment and the educational attainment ($\beta_3 \times I_{it} \times E_i$) can be formalised as[7]:

$$Y_{it} = \beta_1 + (\beta_2 \times I_{it}) + (\beta_3 \times I_{it} \times E_i) + \delta_t + \alpha_i + \varepsilon_{it}$$

4. Empirical analysis

Before addressing the results from the fixed-effects models, some descriptive findings in figure 1 should be discussed[8]. First, it depicts an overall increase in the mean acceptance of environmental taxes between the first (t_1) and second (t_2) survey wave, despite still being on the reluctant side of paying environmental taxes. Differentiating this t_2-effect between respondents having received the environmental tax information treatment and those who have not proves even more insightful: On average, participants without additional information expressed almost nine times more negative opinions towards environmental taxes. This variance in responses lends support to further analyses regarding this information effect.

What is more, there seem to be stark disparities between education groups, both before and after they were presented with the environmental tax information treatment. In t_1, on average, less educated people voiced much more reluctance to paying higher taxes for environmental purposes than other education groups. Overall, only respondents with a university degree were inclined to accept these higher environmental taxes in t_1 already. In t_2, the two lower education groups, regardless of having received the information treatment, uttered more positive opinions about environmental taxes, which might suggest that either an outside event or the survey itself influenced all respondents to improve their support to some degree between the first and second survey wave. University graduates seem to pose a special case however: In t_1, the treatment and control group already differ drastically in their willingness to pay green taxes, which might be problematic for fixed-effects model assumptions. It further shows that, for those university respondents without the information treatment, their previously slightly negative willingness to paying green taxes changed minimally onto the positive side. However, for those having received the information treatment, willingness to pay green taxes even decreased. To determine whether these descriptive findings are of substantial importance, the results from the fixed-effects models will later-on prove insightful.

[5] While (social) acceptance is more passive and at least defined as 'lack of objection', support includes a more active dimension because citizens have to actively agree to something (Batel *et al* 2013). They are used synonymously in this paper.

[6] Control variables other than the classic time-constant variables like age and gender, such as attitudinal variables, were only measured once and could therefore not be included either for the fixed-effects model.

[7] Due to education being time-invariant, there is no separate coefficient for education, as its effect is captured in α_i. This also becomes evident in the model in appendix E1.

[8] More detailed descriptive statistics about the tax-variable can be found in appendix C.

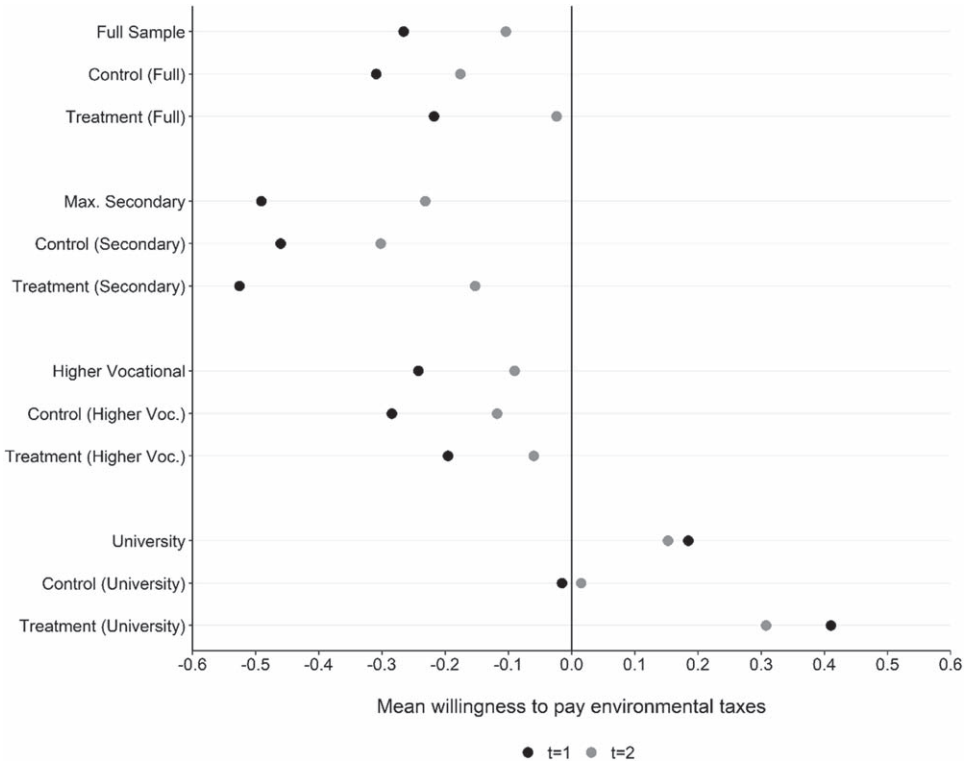

Figure 1. Descriptive findings. Data source: Staehli *et al* (2021a), own calculations and depiction.

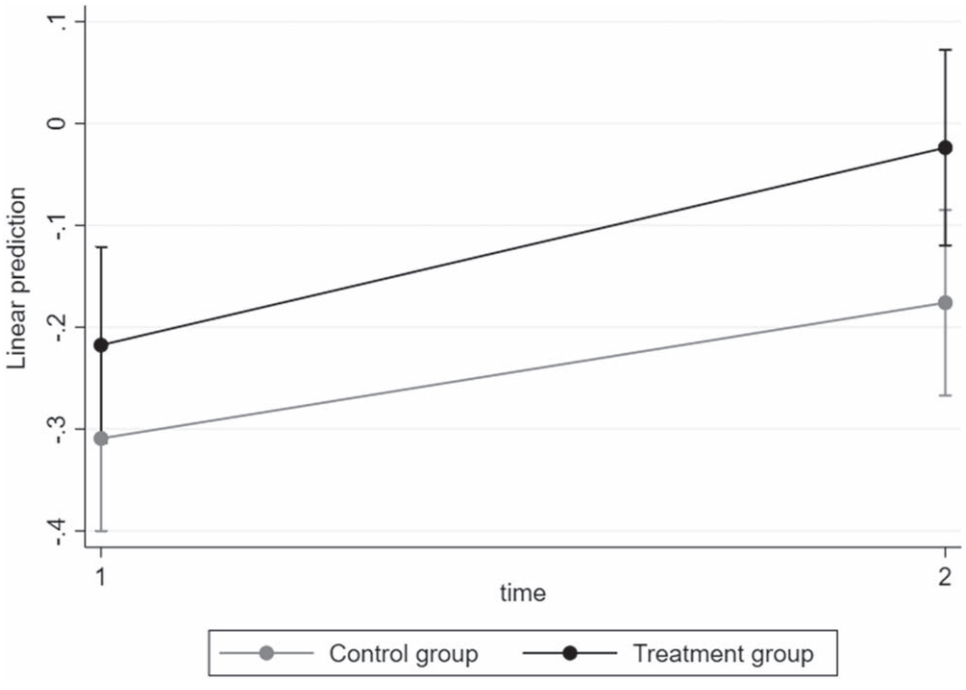

Figure 2. Difference-in-differences model. Data source: Staehli *et al* (2021a), own calculations and depiction.

Figure 2, displaying a difference-in-differences model, shows that willingness to pay green taxes increased for both groups but slightly more so for the treatment group, which could be indicative of an information effect.

The fixed-effects model (see table 2) however shows that, regardless of belonging to the treatment or control group, over time, people increased their willingness to pay higher environmental taxes by 0.13 scale points (p-value: 0.001). The information effect amounted to 0.06 but proved to be statistically insignificant (p-value: 0.303). As previously stated, additionally and as a robustness check, models including the dependent variable as

Table 2. Fixed-effects model.

Acceptance of paying much higher environmental taxes					
	Coefficient	*Robust SE*	*P > | t |*	*95% confidence interval*	
Information effect	0.0606	0.0587	0.303	−0.0547	0.1758
Time effect	0.1332	0.0394	0.001	0.0558	0.2106
Constant	−0.2658	0.0146	0.000	−0.2945	−0.2371
Sigma_u	1.0326				
Sigma_e	0.7030				
Rho	0.6833				
R^2 (overall)	0.0064				
Number of observations	2'310				
Number of groups	1'155				

Data source: Staehli *et al* (2021a), own calculations.

the change in willingness to pay green taxes between the two points in time were calculated. The empty model naturally confirmed the findings from the fixed-effects regression (appendix D1), however, the model including control variables altered results somewhat (see appendix D2). Here, respondents of the treatment group were, on average, 0.12 scale points more willing to pay higher environmental taxes than those of the control group (p-value: 0.095). Due to falling short of conventional statistical thresholds, hypothesis H_1, stating that information about environmental taxes increases acceptance of these taxes, is rejected. Still, it might be an indication of a possible information effect and its practical implications should not be completely disregarded. Serving as a sign that the broad public might not fully understand the functioning of environmental taxes, policymakers should encourage a broader provision of such information to increase their chances of gaining majority support regarding green taxes.

After having established that there does not seem to exist a general information effect for green tax acceptance, coming back to the descriptive differences found earlier, the question remains as to whether differently educated people are unequally affected by the information treatment. As previously stated, since environmental taxes are not trivial to grasp per se, better educated people might have an advantage to understanding them, thus profiting more from additional information. On the other hand, the information effect could be especially strong for less educated people as they might profit most from additional information. Turning to the results of the fixed-effects interaction model, they confirm hypothesis H_2. Compared to respondents with secondary education degrees or less, those with higher vocational education or even a university degree seem to benefit less from reading information about environmental taxes (see appendix E1 for the full model and appendix E2 for average marginal effects). However, as depicted in figure 1, especially for university graduates, the control and treatment groups might not have been identical before the group assignment. Therefore, as a robustness check, another model including the dependent variable as the change in willingness to pay higher environmental taxes and a variety of control variables to account for group differences is analysed (see appendix F1). These results corroborate the fixed-effects findings, indicating that, compared to people with a secondary education degree or less, respondents with higher vocational education and university graduates profited less from reading the information treatment by 0.27 (p-value: 0.091) and 0.39 (p-value: 0.028) scale points, respectively. The average marginal effects in figure 3 (appendix F2) visualise that treated respondents with a maximum of secondary education were, on average, 0.21 scale points (p-value: 0.015) more willing to pay higher environmental taxes than their counterparts without additional information. With the tax acceptance variable's standard deviation being 0.99, the coefficient's effect size amounts to 22% of it. Hence, this information effect clearly stresses the relevance of what Dahl's (1989) enlightened understanding of democracy pointed at.

To sum up, the data at hand produced an inconsistent information effect regarding willingness to pay higher environmental taxes for the full sample. This coincides with existing research, which partially identified information effects. I argued that this previous disunity might stem from a non-universal information effect which only affects parts of the population. This presumption seemed to be correct, as the information effect in this study differed depending on the respondent's degree of education. The findings are also in line with Dahl's (1989) enlightened understanding of democracy and were able to reduce the knowledge gap, pinpointing to the need for better informing less educated people, since the information treatment was able to improve these respondents' opinion on environmental taxes. This, of course, is also relevant from a policymaking perspective. While this design could not explicitly test for the framing of the information treatment, results still indicate that there is a good chance that highlighting the often misunderstood aspect of tax redistribution and revenue use leads to higher willingness to pay these taxes, at least for less educated people. With taxes being one of the most

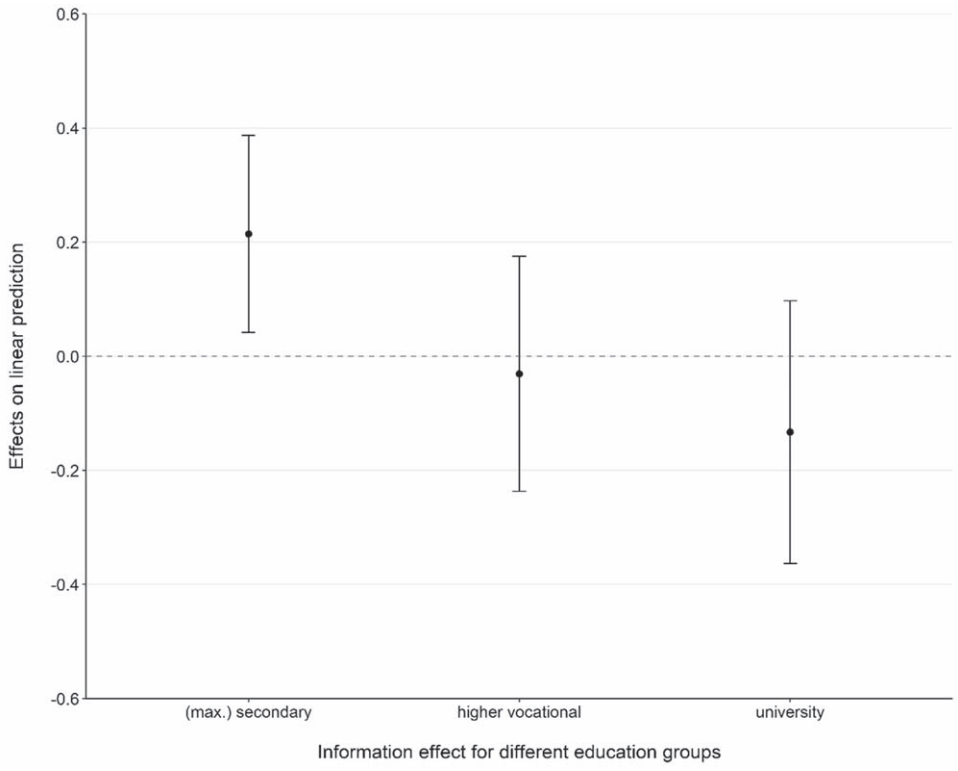

Figure 3. Average marginal effects. Data source: Staehli *et al* (2021a), own calculations and depiction.

efficient measures in changing behaviours, policymakers should make use of this finding in order to better combat climate change.

5. Conclusion and policy implications

5.1. Summary

To briefly summarise the results, first, it could be shown that respondents who received information about environmental taxes were not consistently more willing to pay them than respondents without this information treatment across various models. However, splitting up the sample into different education groups proved relevant. The environmental tax information effect was positive for the least educated respondent group at the 5% level but insignificant for respondents with higher vocational education and university degrees.

5.2. Limitations

The article at hand is certainly not without limitations. A first point of criticism concerns the dependent variable, willingness to pay higher environmental taxes. Despite its strong item formulation, which only intended to capture people who were truly willing to pay higher green taxes, it still asks for respondents' subjective assessment and hence cannot guarantee real-life willingness to pay them. Another issue might arise due to attrition bias and sample representativeness: While around 4'300 citizens took part in the first survey wave and around 3'100 in the second wave, only 1'155 respondents answered all necessary questions needed for both waves. Despite showing that the panel sample does not differ substantially from the full sample regarding various sociodemographic variables, some groups, such as voters from green parties, are slightly overrepresented compared to the Swiss population. And secondly, despite other research pointing to durable information effects in the context of climate change education (see Ranney and Clark 2016), this experiment only measured rather short-term information effects and nothing is known about the longevity of them in real-life situations. Whether these results are generalisable outside of Switzerland or, if at all, only apply to countries similar in respect to degree of democracy or familiarity with other environmental taxes remains open.

5.3. Policy implications

The results nonetheless have both scientific and practical policy implications. As stated, since environmental taxes are deemed to be one of the most efficient ways to alleviate climate change and its negative implications, it is

of crucial importance to find the extrinsic drivers of boosting environmental tax acceptance that go beyond personal characteristics, which are, per definition, hard to change. By introducing a soft policy instrument like information, citizens can learn about the functioning and purpose of environmental taxes and adapt their opinion on them. Since information effects were identified for the least educated respondent group, i.e. they updated their opinion on environmental taxes, this stresses the importance of 'enlightening' people (Dahl 1989). It is also in line with the assumptions of the information deficit model: While it cannot be denied that other personal and contextual factors contribute at least to initial attitude *formation*, receiving information still proves influential for some population groups when it comes to attitude *change*. At least this was the case when respondents were presented with this balanced information treatment. This has two implications: First, policymakers in general should provide the public with more information about the functioning and purpose of green taxes. And second, despite being unable to specifically test for framing effects in this study, this finding could translate into the suggestion for policymakers to abstain from using political-ideological messaging as much as possible when distributing information about a new policy instrument (for example in the Swiss voting booklet distributed for all ballot proposals). Instead, as stated, the functioning and purpose of environmental taxes should be formulated more factually in order to gain societal support.

From a societal point of view, keeping in mind that since average willingness to pay environmental taxes was still slightly negative even for participants having read information about these taxes, the impact of this information effect for less educated people should not be overly emphasised. Nonetheless, as information indeed seems to bridge the gap between education groups regarding acceptance of green taxes, this implies that information is an effective tool to prevent the formation of an even wider gap between different education groups. I therefore recommend conducting further subgroup analyses, also for contexts apart from the field of environmental taxes, since this study managed to offer an explanation for the heterogeneity of previous research regarding information effects.

Data availability statement

The data cannot be made publicly available upon publication because they are owned by a third party and the terms of use prevent public distribution. The data that support the findings of this study are available upon reasonable request from the author. https://doi.org/10.23662/FORS-DS-1232-1.

Disclosure statement

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Appendix A. Frequency table (in %)

	(max.) secondary education	Higher vocational	University	*Total*
SVP	12.45	5.56	1.67	19.68
BDP	1.06	0.92	0.20	2.18
FDP	7.61	5.63	3.31	16.54
CVP	5.22	3.24	1.16	9.62
GLP	4.06	4.26	3.41	11.73
EVP	0.61	0.95	0.24	1.81
GPS	6.62	6.45	4.64	17.70
SP	9.79	6.86	4.09	20.74
Total	47.41	33.87	18.72	100

Data source: Staehli *et al* (2021a), own calculations.

Appendix B. Codebook

Variable	Item formulation	Coding
Environmental tax acceptance	How willing would you be to pay much higher taxes in order to protect the environment?	-2—very unwilling -1—fairly unwilling 0—neither willing nor unwilling 1—fairly willing 2—very willing
Information treatment	With environmental taxes, we want to influence people's behaviour. When electricity is taxed, the price of electricity goes up. As a result, we consume less energy because it costs more. The tax on electricity allows the state to receive money. For example, it can use that money to promote renewable energy, such as hydro, solar and wind power. Some scientists say that it is a good thing that money from an electricity tax is redistributed to the population: 'People are rewarded for using less electricity. And it doesn't cost the government anything.'	0—no treatment received 1—treatment received
Education	What is the highest level of education that you have attained?	1—(max.) secondary education 2—higher vocational 3—university
Age	In which year were you born?	1—aged 19-29 years 2—aged 30-39 years 3—aged 40-49 years 4—aged 50-59 years 5—aged 60-69 years 6—aged 70-79 years 7—aged 80-90 years
Sex	Are you male or female?	0—male 1—female
Income	Before taxes and other deductions, what on average is you own total monthly income? (net income)	1—Less than CHF 3'300 2—CHF 3'300 to less than CHF 4'300 3—CHF 4'300 to less than CHF 5'300 4—CHF 5'300 to less than CHF 6'400 5—CHF 6'400 to less than CHF 7'500 6—CHF 7'500 to less than CHF 8'800 7—CHF 8'800 to less than CHF 10'300 8—CHF 10'300 to less than CHF 12'200 9—CHF 12'200 to less than CHF 15'600 10—CHF 15'600 or more
Party choice	For which party did you vote at the last federal elections in October 2019?	1—SVP 2—BDP 3—FDP 4—CVP 5—GLP 6—EVP 7—GPS 8—SP
Place of living	Would you describe the place where you live as…?	1—urban 2—agglomeration 3—rural
Main problem	Which of these issues is the most important for Switzerland today?	1—economy 2—environment 3—poverty 4—immigration

(Continued.)

Variable	Item formulation	Coding
		5—health care 6—education 7—crime / terrorism
Environmental concern	Generally speaking, how concerned are you about environmental issues?	1—not at all concerned 2 - 3 - 4 - 5—very concerned

Source of 'item formulation': Staehli *et al* (2021a), own recoding.

Appendix C. Descriptive statistics for taxes

Tax acceptance of…	Number of observations	Mean	Standard deviation	Minimum	Maximum
Overall	2'310	−0.1848	1.1493	−2	2
T1: overall	1'155	−0.2658	1.2114	−2	2
T1: no information	608	−0.3092	1.1944	−2	2
T1: with information	547	−0.2176	1.2293	−2	2
T2: overall	1'155	−0.1039	1.0782	−2	2
T2: no information	608	−0.1760	1.0725	−2	2
T2: with information	547	−0.0238	1.0799	−2	2
T1: (max.) secondary education (overall)	501	−0.4910	1.1447	−2	2
T1: (max.) secondary education (no information)	265	−0.4604	1.1544	−2	2
T1: (max.) secondary education (with information)	236	−0.5254	1.1352	−2	2
T1: higher vocational education (overall)	388	−0.2423	1.2085	−2	2
T1: higher vocational education (no information)	204	−0.2843	1.1942	−2	2
T1: higher vocational education (with information)	184	−0.1967	1.2258	−2	2
T1: university degree (overall)	249	0.1847	1.2239	−2	2
T1: university degree (no information)	132	−0.0151	1.2293	−2	2
T1: university degree (with information)	117	0.4103	1.1829	−2	2
T2: (max.) secondary education (overall)	501	−0.2315	1.0575	−2	2
T2: (max.) secondary education (no information)	265	−0.3019	1.0586	−2	2
T2: (max.) secondary education (with information)	236	−0.1525	1.0529	−2	2
T2: higher vocational education (overall)	388	−0.0902	1.0709	−2	2
T2: higher vocational education (no information)	204	−0.1176	1.0718	−2	2
T2: higher vocational education (with information)	184	−0.0598	1.0721	−2	2
T2: university degree (overall)	249	0.1526	1.0966	−2	2
T2: university degree (no information)	132	0.0152	1.0841	−2	2
T2: university degree (with information)	117	0.3077	1.0944	−2	2

Data source: Staehli *et al* (2021a), own calculations.

Appendix D1. Model with DV 'change in tax acceptance between two points in time'

	Acceptance of paying much higher environmental taxes				
	Coefficient	Robust SE	$P>\|t\|$	95% confidence interval	
Information effect	0.0606	0.0586	0.302	−0.0544	0.1755
Constant	0.1332	0.0403	0.001	−0.0541	0.2123
R2	0.0009				
Number of observations	1'155				

Data source: Staehli *et al* (2021a), own calculations.

Appendix D2. Model with DV 'change in tax acceptance between two points in time', including control variables

	Acceptance of paying much higher environmental taxes		
	Coefficient	Robust SE	$P>\|t\|$
Information effect	0.1174	0.0702	0.095
Age	−0.0005	0.0022	0.813
Sex: female	0.0177	0.0727	0.807
Education: (max.) secondary			
higher vocational	−0.0798	0.0840	0.343
university	−0.1211	0.0960	0.207
Income	−0.0257	0.0139	0.066
Main problem: economy			
environment	−0.2077	0.1445	0.151
poverty	0.2621	0.1947	0.179
immigration	−0.0830	0.1730	0.631
health care	−0.1227	0.1374	0.372
education	−0.1750	0.1603	0.275
terrorism/crime	−0.3680	0.4118	0.372
Party: SVP			
BDP	−0.1318	0.2294	0.566
FDP	−0.0663	0.1340	0.621
CVP	0.1470	0.1482	0.321
GLP	−0.0546	0.1402	0.697
EVP	0.0532	0.3141	0.866
GPS	−0.3617	0.1435	0.012
SP	−0.2285	0.1295	0.078
Environmental concern	−0.0379	0.0398	0.341
Place of living: Rural			
Agglomeration	−0.0281	0.1053	0.790
Urban	−0.0508	0.0781	0.515
Constant	0.7367	0.2333	0.002
R2	0.059		
Number of observations	805		

Data source: Staehli *et al* (2021a), own calculations.

Appendix E1. Fixed-effects interaction model

	Acceptance of paying much higher taxes				
	Coefficient	Robust SE	$P>\|t\|$	95% confidence interval	
Information effect	0.2400	0.0767	0.002	0.0892	0.3903
Time effect	0.1331	0.0398	0.001	0.0551	0.2111
Education			*Omitted due to collinearity*		
Information * Education (baseline: (max.) secondary)					
Information * higher vocational	−0.2370	0.1014	0.020	−0.4359	−0.0381
Information * university	−0.4754	0.1061	0.000	−0.6835	−0.2674
Constant	−0.2583	0.0146	0.000	−0.2870	−0.2297
Sigma_u	1.0462				
Sigma_e	0.6980				
Rho	0.6920				
R2 (overall)	0.0000				
Number of observations	2'276				
Number of groups	1'138				

Data source: Staehli *et al* (2021a), own calculations.

Appendix E2. Fixed-effects interaction model—average marginal effects

	Acceptance of paying much higher taxes				
	Coefficient	Robust SE	$P>\|t\|$	95% confidence interval	
Information * secondary education	0.2398	0.0767	0.002	0.0894	0.3901
Information * higher vocational education	0.0028	0.0869	0.975	−0.1676	0.1731
Information * university	−0.2357	0.0923	0.011	−0.4166	−0.0547
Number of observations	2'276				

Data source: Staehli *et al* (2021a), own calculations.

Appendix F1. Interaction model with DV 'change in tax acceptance between two points in time'

	Acceptance of paying much higher taxes			
	Coefficient (Robust SE)	$P>\|t\|$	Coefficient (Robust SE)	$P>\|t\|$
Information effect	0.2144 (0.0882)	0.015	0.3034 (0.1095)	0.006
Education: (max.) secondary				
higher vocational	0.0082 (0.0921)	0.929	0.0407 (0.1058)	0.701
university	−0.1282 (0.1013)	0.206	0.0619 (0.1271)	0.627
Information * secondary education				
Information * higher vocational education	−0.2452 (0.1371)	0.074	−0.2699 (0.1597)	0.091
Information * university	−0.3473 (0.1467)	0.018	−0.3909 (0.1777)	0.028
Age			−0.0007 (0.0022)	0.754
Sex: Female			0.0143 (0.0725)	0.844
Income			−0.0250 (0.0139)	0.072
Main problem: economy				
environment			−0.2106 (0.1430)	0.141
poverty			0.2671 (0.1933)	0.167
immigration			−0.0775 (0.1721)	0.652
health care			−0.1085 (0.1361)	0.426
education			−0.1638 (0.1586)	0.302
crime/terrorism			−0.3162 (0.4127)	0.444
Party: SVP				
BDP			−0.1133 (0.2247)	0.614
FDP			−0.0564 (0.1337)	0.673
CVP			0.1545 (0.1481)	0.297
GLP			−0.0602 (0.1398)	0.667
EVP			0.0789 (0.3102)	0.799
GPS			−0.3464 (0.1432)	0.016
SP			−0.2240 (0.1299)	0.085
Environmental concern			−0.0354 (0.0395)	0.371
Place of living: Rural				
Agglomeration			−0.0387 (0.1051)	0.713
Urban			−0.0532 (0.0779)	0.495
Constant	0.1585 (0.0588)	0.007	0.6391 (0.2362)	0.007
Number of observations	1'138		805	

Data source: Staehli *et al* (2021a), own calculations.

Appendix F2. Interaction model with DV 'change in tax acceptance between two points in time'—average marginal effects

	Acceptance of paying much higher taxes				
	Coefficient	Robust SE	$P>\|t\|$	95% confidence interval	
Information * secondary education	0.2144	0.0882	0.015	0.0414	0.3874
Information * higher vocational education	−0.0308	0.1050	0.769	−0.2368	0.1752
Information * university	−0.1329	0.1173	0.258	−0.3630	0.0973
Number of observations	1'138				

Data source: Staehli *et al* (2021a), own calculations.

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