In search of politically feasible policy-packages for sustainable passenger transport: insights from choice experiments in China, Germany, and the USA

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Abstract

The main obstacle to making the transportation sector ecologically more sustainable is political feasibility. Effective policy-interventions usually encounter strong public opposition as they interfere in costly ways with people’s daily lives, unveiling a dilemma between political feasibility and environmental policy effectiveness. Evidencing the existence of this dilemma, the literature on attitudes towards different policy instrument types maintains that so-called push measures are less supported by citizens than pull measures, and that market-based instruments tend to be less supported than non-market instruments. While these findings may uphold when considering single policy instruments, whether they continue to do so when considering policy-packages, that is, simultaneously implemented policy-interventions consisting of several policy instruments, remains unclear.

To identify politically feasible and effective policy-packages aimed at greening the transportation sector we use choice experiments with representative samples of citizens from China, Germany, and the USA (N = 4'876). Contrary to existing literature, we find that public support does not necessarily depend on the instrument type but rather on specific policy design and is highly context dependent. Moreover, despite significant differences between the three country contexts considered, various combinations of policy measures appear to be both potentially effective and supported by most citizens. Altogether, these results suggest that carefully bundled policy-packages may allow governments to employ instruments that would not be politically feasible if introduced in isolation.

1. Introduction

Over the past decades, rapidly increasing numbers and usage of motorised vehicles powered by fossil-fuel have contributed to severe local air pollution problems, global climate change, and various other sustainability challenges (Rockström et al 2017, Nieuwenhuijsen 2018). In 2016, the transportation sector was responsible for one quarter of global CO2 emissions, of which three quarters were caused by road transport (IEA 2018). In most countries, transportation is among the sectors where emissions are still increasing (Gössling and Cohen 2014). This predicament calls for much stronger policies to bridge the gap between GHG emission reductions foreseen under current policies and the emission cuts that would be required to limit global warming (EASAC 2019).

While many governments have progressed in reducing emissions from other sectors, efforts to reduce emissions from motorised vehicles have been much less successful (Gössling and Cohen 2014, Creutzig et al 2015, Santos 2017). Arguably at fault, environmentally effective interventions tend to interfere in costly ways with the daily lives of people and thus encounter strong societal opposition. Such policies are hardly implemented as policy-makers tend to adopt policies supported by the population majority (Stehr 2015, Anderson et al 2017). This results in a dilemma between political feasibility and policy effectiveness, where potentially effective policy-interventions run into political feasibility problems and vice versa (Marcantonini and Ellerman 2015, Carattini et al 2017, Gunningham and Sinclair 2017). Nonetheless, we argue that this presumed dilemma is unlikely an ‘either-or’ problem and,
instead, poses a challenge in designing policy-interventions that are as effective as political feasibility considerations allow. We aim to explore public support as one important part of political feasibility—acknowledging that interest groups and other factors also play an important role.

Thus far, most political support assessments analyse citizens’ preferences for particular policy instruments in isolation, and not in combination. This empirical approach, however, may not accurately reflect how policy-making actually unfolds and may raise analytical issues of whether published findings on push versus pull and market- versus non-market-instruments uphold when they appear in policy-packages, that is an appropriate combination of different policy instruments merged into one proposal (Howlett and Rayner 2013, Givoni 2014). Push measures tend to encounter greater political feasibility problems than pull measures (Steg et al 2006, Rhodes et al 2017), similarly to market-based versus non-market instruments (Dresner et al 2006, Stadelmann-Steffen and Dermont 2018). Push measures (e.g. bans) attempt to alter behaviour by making unsustainable behaviour unattractive. Pull measures (e.g. subsidies) make sustainable behaviour more attractive (Clayton 2018). Market-based instruments (e.g. taxes) use price mechanisms to make unsustainable behaviour more costly (Dargusch and Griffiths 2008, Böcher 2012). Non-market-based instruments amalgamate information-based instruments, aiming at people’s knowledge and attitudes likely affecting behaviour, and command-and-control instruments, which set standards by regulating consumers and producers directly (Vedung 1998, Howlett 2011).

Although analysing individual policy instruments proves highly effective for both, a policy’s political feasibility and its problem-solving effectiveness, this approach has important limitations. First and foremost, policy-interventions often materialise in sets of several policy instruments, rather than a single one. Thus, policy-packaging has emerged as part of the economic policy literature on how fiscal and monetary policy interact (Mundell 1962, Flanagan et al 2010). While this strand has gained scholarly attention (Baron et al 2017, Marcucci et al 2017), existing research mainly focuses on how packaging policies influence policy effectiveness. Givoni (2014) criticises this focus on design effectiveness and encourages further research on the impact of policy-packages on political feasibility. More recent research on congestion pricing argues that policy-packaging, mainly focusing on ancillary measure (e.g. public transportation support) and (redistributive) allocation of revenues, increases the chances of successful implementation, compared to singular policy measures (Jusen et al 2014, Sørensen et al 2014, Andersson and Nässén 2016). Lastly, Häusermann et al (2018) focus on public support for a pension reform in Switzerland that packages policies regarding old-age pensions, such as pension cutbacks and subsidies for early retirement.

Research on how policy-packaging affects public support is still quite rare (notable exceptions are Eriksson et al 2008, Häusermann et al 2018, Wicki et al 2019) and lacks country comparative scopes of preferences for these policy typologies. This paper aims to explore whether pessimism about the political feasibility of environmentally-effective market-based and push measures is justified when considering these measures as parts of larger policy-packages. Thus, it becomes imperative to determine what combinations of instruments, ideally combinations that include presumably effective policies, can survive the political feasibility test (Bernauer et al 2018).

In addressing this research gap, we use conjoint experiments in China, Germany, and the USA to address these questions in a comparative research setting. We exposed representative samples of citizens from these three countries (N = 4’876) to policy-packages that included various push and pull measures as well as market-based and non-market-based measures. Since the push/pull and market/non-market typologies overlap to some extent, we selected six specific and realistic policy instruments distinguishable by the two typologies based on explorative expert interviews. We particularly focus on fossil-fuel-tax (market-based/push), revenue recycling from such a tax, reduction of subsidies for the fossil-fuel car industry (market-based/push), financial support for public transportation (market-based/pull), restricting access of fossil-fuelled cars to downtown areas (non-market-based/push), emission requirements for newly registered cars (non-market-based/push), and information campaigns (non-market-based/pull).

From previous research, we expect market-based and push measures to be the least supported, whereas non-market and pull measures should receive most support. Random assignement of study participants to policy-package proposals, with variation within the six policy instruments, allows for causal inference on public support. Consequently, our comparative study design generates responses to two types of questions; first, which policy measures are most supported by citizens? Second, what kinds of policy-packages are, as a whole, more supported? We find that public support does not necessarily depend on instrument type but on specific policy design features instead. Overall, we conclude that policy-packaging allows to introduce policies that are likely to be unfeasible when implemented in isolation.

2. Arguments

One widely studied characteristic of policy-interventions is the type of behavioural change mechanism activated by a particular policy instrument. Notably, behavioural change mechanisms vary in a policy’s
Inherent degree of coerciveness. That is, such mechanisms vary on a continuum from non-coercive to coercive (Gärling and Schuitema 2007). Pull measures (e.g. campaigns) are located at the non-coercive end of the continuum and provide incentives and rewards to encourage behavioural changes. In contrast, push measures are more coercive, as they disincentivise, restrict, and/or prohibit types of behaviour, while also sanctioning non-compliance with certain norms and rules (Walton and Gardner 2014). While such analyses of citizens’ preferences for policy instruments in isolation has been studied widely, it is less clear whether these findings on behavioural change mechanism uphold when policies are integrated into policy-packages. Based on the above considerations, and in line with prior research, we expect that push measures are also likely to be less supported by citizens than pull measures when integrated into policy-packages (de Groot and Schuitema 2012).

H1 Push measures garner less support than pull measures when integrated into policy-packages

In real-world policy-making, non-market-based instruments are more common than market-based instruments, arguably because non-market instruments tend to garner more support from the mass public (Felder and Schleining 2002). Stadelmann-Steffen (2011) shows that voters usually prefer command-and-control policies over market-based instruments (also see Kirchgässner and Schneider 2003). Cherry et al (2012) arrive at a similar conclusion. The reasoning for why command-and-control measures may obtain more support relates to cost visibility. Market-based instruments, by nature, generate monetised information about policy effects, something command-and-control measures do not (Schulz 2001) and which allows voters to underestimate these (Kirchgässner and Schneider 2003) as the costs of information-based instruments are less visible to citizens. Although voters preferences for command-and-control over market-based-instruments appears plausible, empirical research has thus far produced mixed results (Pleger 2017).

Moreover, while most environmental economists regard market-based instruments (e.g. taxes) as the most efficient approach to mitigating negative externalities (Hahn and Stavins 1992, Dargusch and Griffiths 2008), studies show that de facto use of environmental taxes is limited—probably a result of political feasibility problems (Cherry et al 2012). Research has shown that earmarking revenues potentially increases public support when a tax is included. A choice experiment by Saelen and Kallbekken (2011) on fuel taxation in Norway shows that, without earmarking, a majority of voters favour fuel-tax reductions, whereas earmarking revenues towards environmental measures leads to a significant upsurge in support for fuel-tax increases (also see Kallbekken and Aasen 2010). Likewise, a stated preference survey by Bristow et al (2010) shows that support for carbon taxes can increase depending on earmarking. In addition to fuel-tax revenue recycling, so-called ancillary measures can significantly increase public support levels when including fuel-taxes into policy-packages (Wicki et al 2019).

Similarly, the existing literature also shows that information-based measures (e.g. information campaigns) attract relatively high levels of public support (Fischer et al 2011, Drews and van den Bergh 2016). In line with these arguments, and accounting for expectations regarding the two different policy-types together, we expect that coercive and visibly costly policies will also receive least support when integrated into policy-packages. Conversely, policy measures that are non-coercive and are characterised by comparably low financial cost visibility are likely to receive the most support.

H2 Market-based policy instruments receive less public support than non-market-based instruments when integrated into policy-packages

Additionally, we argue that specific design features of individual policy instruments may, however, also affect public support. For taxation instruments, for example, public support levels may depend on the use of revenues derived from taxation. Klentner et al (2018) review studies on how carbon tax revenues could be used to increase public support and recommend that equal per capita transfers, earmarking revenues for green spending, or directed transfers to particularly affected groups are necessary to ensure public support and the political longevity of carbon tax reforms (Baranzini and Carattini 2017, Fairbrother 2017).

H3 The use of revenues for the general budget receives least support compared to other earmarking strategies

The contribution of our paper is twofold: first, we test the validity of previous findings on policy (type) preferences and of the three hypotheses when policy instruments are integrated into policy-packages, rather than evaluated in isolation. However, we acknowledge that the theoretical grounds for policy types are somewhat weaker than for the policy instruments per se. Second, given that little comparative research on policy preferences along the policy typologies exists to date, we test the validity of existing empirical findings and the three hypotheses across different countries.

3. Empirical study design

3.1. Policies

To select a set of meaningful and relevant policy instruments for our empirical analysis, we conducted...
explorative, semi-structured interviews with leading experts on transportation policy in the three countries at hand. Based on these interviews, we selected six realistic policy instruments that are potentially considered for implementation and differ with respect to coerciveness and visibility of financial implications. We juxtaposed these six policy instruments on the push/pull and market/non-market instruments distinction (see table 1).

Policy instruments can also be categorised in accordance with their primary target group (Creutzig et al 2015). While five of our six instruments focus on consumers (citizens), the ‘reduction of subsidies for the (fossil-fuel) car industry’ is directed at industry and does not burden citizens/consumers directly. For the latter reason we expect such supply-side measures to be more supported by citizens than measures that affect them directly and financially.

3.2 Country selection
In February 2018, we implemented survey experiments using quota-based online samples consisting of a total of 4’876 respondents in China (N = 1’624), Germany (N = 1’626), and the USA (N = 1’626). These three countries were selected due to differences in socio-economic, cultural, and political systems, similarities in economic size, vehicle production industry, and political relevance in shaping global production and trading systems through changes in domestic demand and policy. This country selection increases the generalisability of the results. The three are also among the ten countries with the highest total ecological footprint worldwide (Global Footprint Network 2018), thus, their policies have a substantial impact on global environmental change and governance. Political economy literature has also looked at economic and political dimensions of globalisation on the environment (see Spilker et al 2017 for a literature review). In this respect, the three countries at hand are pivotal examples as they represent important markets and powerful political stakeholders from a global perspective, i.e. shaping global production and trading systems through changes in domestic demand and policy.

3.3 Survey experiment
To assess our theoretical arguments, we use a conjoint experiment5, which is particularly useful in studying causal effects of multiple variables in complex preference formation or decision-making processes (Rienstra et al 1999, Hainmueller et al 2014). At the beginning of our conjoint experiment, we provided basic information on each of the policy instruments and continued with instructions for completing the experiment. Table 2 shows the attributes and their description.

Since all attribute characteristics were randomly assigned into the tables, average marginal component effects (AMCE) can be estimated (Louviere et al 2000, Hainmueller et al 2014). We also estimate marginal means displaying the rate at which the dependent variable changes with respect to the respective predictor while holding other predictor variables constant (Leeper et al 2019). To avoid ordering effects and cognitive

Table 1. Policy Instruments.

|                | (financial) cost visibility | coercive | Market-based | Non-market-based |
|----------------|-----------------------------|----------|--------------|-----------------|
| Push           | high                        | coercive | Taxes on fossil-fuels (including tax revenue recycling options) | Restricting access of fossil-fuelled cars to downtown areas |
|                | low                         | non-coercive | Reduction of subsidies for the (fossil-fuel) car industry | Emission limits for newly registered cars |
| Pull           |                             |          | Financial support for public transportation | Information Campaigns |

4 See table A1 in appendix A1 summarising the survey sample.

5 For further details discussing the survey and sampling strategy, see appendix A1. Data and replication materials can be found at Wicki (2019).
Information transformed to the miles per gallon standard for the USA. More specifically, it stated 'At least 40 (55) miles per gallon'.

overload, the order of the attributes was randomly assigned to each participant and was held constant for all four choice tasks.

4. Empirical findings

Figure 2(A) displays the AMCEs by country, for both the choice and the rating scale. The two push-measures of always restricting access of fossil-fuelled cars to downtown areas and a fossil-fuel-tax increasing prices by 30% have the most negative effect on support for policy-packages, contrasting the pull measure to reduce prices of public transportation which increased policy support. Emission requirements for newly registered cars contribute more to support for policy-packages, compared to the baseline of no new requirements—although with significant country differences. The same holds for information campaigns. Overall, pull measures received the most support from Chinese participants. Although not statistically different from the other two countries regarding a price reduction in public transportation, China is the only country with a significant positive effect of implementing information campaigns. These results tend to support H1, which holds that push measures garner less support compared to pull measures and thus have a strong negative effect on overall support for policy-packages. However, our results do not lend support to H2, revealing that market-based policy instruments

| Table 2. Attributes, attribute descriptions, and attribute characteristics. |
|-------------------------------------------------|
| Attribute (policy instrument) | Description | Attribute characteristics (form of policy instrument) |
| New tax on fossil-fuels: | The government could introduce a new tax on fossil-fuels, in addition to existing fuel taxes. This tax would increase prices for gasoline and diesel, and would thus motivate people to drive less and use other modes of transportation | No new fuel tax Increasing fuel prices by 15% Increasing fuel prices by 30% |
| Use of fuel-tax revenues: | Income from the additional fuel-tax could be used for different purposes | General government budget Public environmental and climate protection programs Public programs for low-income households Reduction of income taxes (No tax revenues, if no new fuel tax) |
| Restricting access of fossil-fuelled cars to downtown areas: | The government could restrict the use of cars that run on fossil-fuel by limiting their access to downtown areas on certain days. This would motivate people to drive less and use other modes of transportation | Never restricted 1 day per week 3 days per week 5 days per week Always restricted |
| Financial support for public transportation: | The government could increase spending for public transportation, such as trains, buses, or tramways. Improved infrastructure and lower prices for tickets would motivate people to drive less and use other modes of transportation | No increase of support Reducing prices by 15% Reducing prices by 30% |
| Requirements for newly registered cars: | The government could introduce stricter fuel consumption and emission standards for cars. Registration of cars using a lot of gasoline or diesel would therefore be more difficult and expensive. This would motivate people to use cars consuming less fossil-fuel and use other modes of transportation | No new requirements Maximum consumption of 5.9 l/100 km Maximum consumption of 4.3 l/100 km |
| Information campaigns: | The government could organise and fund nation-wide campaigns to inform people about the negative impacts of cars on human health, wildlife, the climate and the environment. This would motivate people to drive less and use other modes of transportation | No campaigns Occasional campaigns Frequent campaigns |
| Reducing subsidies for (fossil-fuel) car industry: | The government could reduce its current financial support (subsidies) for the industry producing cars that run on fossil-fuel. This would result in higher prices for cars that run on fossil-fuel and would motivate people to drive less and use other modes of transportation | Keeping subsidies at current level Halving subsidies Eliminating subsidies |

Note. This table is meant to provide an overview of attributes and their characteristics. In the survey experiment, participants first saw descriptions of the attributes, one by one, and then a shorter overview that also showed the characteristics each attribute might take. The table shown here is a hybrid between the two. All attributes were shown to every participant in all choice tasks. Attributes were ordered randomly for each participant; per participant, this order was then kept constant across all choice tasks to limit the cognitive burden. Attribute characteristics were randomly assigned for each choice task. The attribute ‘Requirements for newly registered cars’ was transformed to the miles per gallon standard for the USA. More specifically, it stated 'At least 40 (55) miles per gallon'.

4 For full sample results, see figure A1 in the appendix.
receive less support than non-market-based policy instruments. On the one hand, the market-based instrument of financial support for public transportation contributes most to support for policy-packages. On the other hand, even though a new fuel-tax is unpopular, study participants in Germany and the USA are more opposed to always restricting access of fossil-fuelled cars to downtown areas, compared to increasing fuel prices by 15% via a new tax. In general, German participants were most opposed to downtown area restrictions, whereas Chinese participants are even in favour of access restrictions 1 or 3 days a week. This finding may be due to the fact that the Chinese public is already used to somewhat similar policies, e.g. road space rationing policies in several Chinese cities where access is allowed based on odd/even license numbers only every second day.

In summary, we find support for H1, but not for H2. While the tax as both a market-based and push measure is indeed among the least supported measures, reducing public transportation prices, which can be characterised as market-based and pull measure, receives most support. In addition, access restrictions, which is a push non-market-based measure, experiences similar rejection levels as the tax does. Moreover, our expectation that market-based and push instruments are the least, and non-market-based and pull instruments the most acceptable policy interventions, is not supported by the empirical results. Yet, while the distinction of policy instruments along the lines of their coerciveness (push versus pull) helps predict public support, the distinction between market-based and non-market-based instruments appears to be not particularly useful in predicting public support for policy-packages.
In line with our expectations in H3, using revenues for the general government budget attracts significantly more opposition when compared to the other three revenue recycling options, in all three countries. Nevertheless, neither of the other earmarking options has a significantly different impact on support levels from one another. Specifically, earmarking revenues for public environmental and climate protection programs does not lead to higher support compared to earmarking for public programs for low-income households or for reducing income taxes.

Figure 2. AMCEs by country (A), Average rating of the policy-packages by country (B) and mean reported rating per policy-package and country (C). Error bars show 95% confidence intervals. AMCE for 'No tax revenue' is not displayed as it was restricted to only appear with the attribute 'no new tax' and thus has a conditional effect.
Overall, Chinese respondents rated the policy proposals highest, with an average of 4.74, followed by USA participants (4.07), and German participants (3.65) (figure 2(B)). Average ratings of the policy-packages tend towards the middle categories of 3–5, meaning that respondents slightly oppose to slightly support the policy-packages they are presented (figure 2(C)).

When looking at the marginal means of attribute characteristics, the aforementioned results slightly change (figure 3). While the results based on marginal means still indicate that stringent push measures, such as increasing fuel prices by 30% and always restricting access to downtown areas, receive only little support, less stringent push measures receive public support as well. Specifically, restricting access to downtown areas on 3 days or less attracts similar support levels as pull measures, and even more support than information campaigns. Altogether, marginal means analysis indicates that pull measures indeed attract high levels of support and that medium-stringent push measures may also attract similar levels.

When designing politically feasible policies, it is imperative to understand how specific policy design elements within a larger policy-package might affect its overall public support. As transportation economists often consider pricing schemes as 'the obviously correct solution to externality regulation' (Bamberg and Rölle 2003; also see Rienstra et al 1999), a closer look at the marginal means for specific attribute characteristics conditional on tax levels appears to be useful. Marginal means in figure 4 show that earmarking tax revenues for income tax reduction or supporting low-income households leads to average ratings above 4 for

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7 For ratings by sociodemographic characteristics, see figures A2 and A3 in the appendix. For a test of significance of differences by sociodemographic characteristics, see table A3 in the appendix.
a fuel-tax that increases fuel prices by 15%. Similarly, and even with stronger effects, a reduction of public transportation prices increases support levels for a fuel-tax in all three countries. This is in line with findings from previous studies that indicate ancillary measures can help increase public support (Wicki et al 2019). Implementing both a fuel-tax and access restriction for downtown areas on more than 5 days leads to majority opposition, notably in the USA and Germany.

Policy-packages that exclude push measures are highly unlikely to be effective. Thus, we are mainly interested in policy-packages which received public support and include taxes, access restrictions, and emission standards for newly registered cars. To identify such policy-packages, we predict support levels for the 6075 policy-packages generated by our conjoint design and including interactions of the single components. Figure 5 displays the distribution of predicted support levels for policy-packages by country and attribute characteristic, displaying two different cut-off points, above 4 indicates indifference and thus non-opposition and above 5, which indicates support ratings. We identified 390 policy-packages attracting predicted average support ratings of 4 or higher (on 7-point-rating-scale) in Germany, and 3782 in the USA. Neither in Germany nor the USA do predictions indicate support levels above 5. In China, however, all possible policy-packages obtain support levels above 4 and 865 policy-packages reach support levels of above 5. To illustrate these results, we identified the potentially most effective, and thus stringent (implying higher behavioural costs), policy-packages that receive the highest sufficient support levels for every country.

For Germany, one stringent policy-package for which our estimates predict support of more than 4 consists of a combination of increasing fuel prices by 15%, reducing income taxes with fuel-tax income, restrict access to downtown areas on 3 days per week, reduce public transportation prices by 30%, introduce standards for newly registered cars focusing on a threshold of a maximum consumption of 5.9 l/100 km, running frequent campaigns, and eliminating or halving subsidies for the fossil-fuel industry. A lower price reduction for public transportation of 15%, in contrast, would prevent vehicle access restrictions.

For the USA, our estimates indicate support levels of 4 or more for a policy-package consisting of a fuel-tax that increases fuel prices by 30%, with fuel-tax income earmarked for any purpose other than the general government budget, includes an access
restriction to downtown areas on 5 days per week, a reduction of public transportation prices by 30%, a soft regulation introduction for newly registered cars (Maximum consumption of 5.9 l/100 km), and will be accompanied by occasional or frequent campaigns and halving or a totally eliminating subsidies.

For China, arguably the most stringent policy-package, which presumably would also be the most effective one, and which still attracts support in the order of 5 or more, consists of a fuel-tax increasing prices by 15%, revenue recycling to reduce income taxes, a 3 days per week access restriction, a public transportation price reduction by 15%, car registration standards of a maximum consumption of 5.9 l/100 km, frequent campaigns, and eliminating or halving of subsidies for fossil-fuel focused industries.

5. Discussion

Overall, we do not find empirical support for the argument that market-based instruments receive less public support than non-market-based measures when bundled together into larger policy-packages. It appears that characterising policies by their coerciveness, and distinguishing between push and pull measures, is analytically more useful. Thus, the distinction of policy measures along market- versus non-market-based instruments is of limited analytical value. While this contradicts earlier findings by Cherry et al (2012) and Stadelmann-Steffen (2011), it is in line with more recent research. Kotchen et al (2013) find no difference in the willingness to pay for emission reduction between cap-and-trade measures, a carbon tax, and GHG regulations. Similarly, Pleger (2017) finds that voters prefer incentive-based policy measures over policy measures on the basis of bans-and-rules.

Still, our results indicate that the specific policy design, rather than particular instrument types per se, affect support levels. In addition, context and policy-package design, rather than policy-types, influence policy support. Future research could investigate particular causal mechanisms that may explain public perceptions of policy-packages and how they may influence public support. In addition, this study explicitly aims at potential policy-packages that are both effective and politically feasible. However, from a theoretical perspective, including policies that

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Figure 5. Distribution of predicted support for policy-packages including the respective attribute characteristic. Note. The results are based on OLS regressions including interactions between the policy-package attributes. The results thus show predicted average rating depending on which other policies were also present.

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8 Equal to at least 40 mpg.
potentially undermine the policy goal could be investigated to study potential reverse effects. Similarly, radical measures such as banning admission of new fossil-fuelled cars could be included into policy-packages for further research.

Additionally, in line with studies that argue country context is vital to evaluate different policy instruments and policy-interventions more broadly, we find noteworthy differences between countries. While we find similar directions in policy design effects across countries, the rating of packages is different. In China, even very stringent packages receive high support ratings, while in the USA and Germany only a smaller number of less stringent packages receives high ratings. Nonetheless, across all three countries we observe that rather similar combinations of policy instruments can pass both the political feasibility test and be environmentally effective. This suggests that policy-packaging could potentially be a useful approach to dealing with the effectiveness-feasibility dilemma in different socio-economic and political contexts. Therefore, our findings imply that policymakers interested in strong emission cuts in the transport sector should adopt a holistic design strategy and package different policy types. To increase public support for costly policies, policymakers should consider packaging different policies aimed at a medium level of policy stringency, as packages which incorporate medium-stringent push measure are likely to receive sufficient support-levels.

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Appendix

A1. Sampling strategy and data analysis

Our conjoint choice experiment was embedded in a non-probability, online survey (Toepoel 2015) designed by the authors and fielded by Ipsos in February 2018 in China, Germany and the USA. All experiments were internet-based. Participants were recruited via the online panels that Ipsos maintains in each country.

For our survey, respondents were pre-selected according to quotas and Ipsos constructed samples that were representative of the national voting age population in the three countries. We used hard quotas for gender, age, and region, according to each country’s latest census data (China in 2010, Germany in 2013, and the USA in 2015). Quotas for gender and age were combined to ensure that each age group was nationally representative in terms of gender distribution. Moreover, we also employed soft quotas for education, income, rural-urban population, and occupation to ensure that the samples were not too skewed with respect to certain socio-demographic groups. An overview on the survey sample by different socio-demographic characteristics is displayed in Table A1.

The quota sampling worked well in Germany and the USA, such that our samples from these two countries closely followed the census distribution on income, education, rural-urban population, and occupation. Yet, given the particularly uneven economic development in China and the nature of the country’s political system, our sample represents the urban middle- and higher-income class whose consumption has the biggest environmental impact and who is politically most influential. Moreover, the higher income and more educated strata of society is the most affected by policy-interventions aimed at greening the transport sector and is thus key to the political

| Table A1. Survey sample by country and sociodemographic characteristics. |
|--------------------------|----------------|----------------|----------------|
|                         | China | Germany | USA  |
| Gender                   |       |         |     |
| Male                     | 806   | 799     | 841 |
| Female                   | 818   | 827     | 785 |
| Age                      |       |         |     |
| 18–24                    | 261   | 153     | 193 |
| 25–34                    | 406   | 242     | 288 |
| 35–44                    | 404   | 257     | 276 |
| 45–54                    | 466   | 328     | 292 |
| 55–64                    | 70    | 242     | 241 |
| 65+                      | 17    | 404     | 336 |
| Income                   |       |         |     |
| 1st Quintile             | 26    | 264     | 247 |
| 2nd Quintile             | 137   | 272     | 340 |
| 3rd Quintile             | 89    | 443     | 390 |
| 4th Quintile             | 165   | 452     | 423 |
| 5th Quintile             | 1207  | 195     | 226 |
| Education                |       |         |     |
| Low                      | 142   | 193     | 543 |
| Medium                   | 361   | 934     | 287 |
| High                     | 1121  | 499     | 796 |
| Total                    | 1624  | 1626    | 1626|
feasibility of such policy changes (Wiedenhofer et al 2016, Zhang et al 2017).

Survey participants first answered a series of socio-demographic items on gender, age, income, education, number of family members, and political ideology\(^9\). They were then asked to provide information on their current patterns of personal use of cars (yearly driving distance and type of car they drive most often, if any), before responding to items on potential sustainability criteria when choosing means of transport and potential sustainability problems associated with fossil-fuel-powered car use. After that, participants entered the experimental part of the survey.

\(^9\) Political ideology questions could not be asked in China due to restrictions on such survey activity.

The average time for survey completion was 18 min in the USA, 17 min in Germany, and 14 min in China. We dropped a total of 79 respondents who completed the survey in six minutes or less, which we assume is the minimum time to complete the survey in an attentive manner (see table A2 for an overview by countries and response duration). The final sample includes 4876 respondents from the three countries (1626 each from Germany and the USA, 1624 from China).
The unit of observation in the resulting dataset is defined by the response (outcome, or dependent) variable, which is the response to each policy proposal. This generates two observations for each choice task and a total of 8 observations per participant (4 choice tasks with 2 proposals each). For a sample of 4'876 participants, the number of observations is thus 39'008. The data analysis is based on linear mixed effects regressions to estimate the AMC and we use individuals as tier 2 group. This is in line with a suggestion by Hainmueller et al (2014) to estimate the effects of different covariates. Figure 2 shows a choice task for purposes of illustration.

The data analysis is based on linear mixed effects regressions to estimate the AMCE (R Core Team 2015). All steps from data recoding to the analyses were done in R. RScripts and the raw data are available upon request. We used the following packages to recode, for the analyses, and the output: cregg (Leeper et al 2018), cjoint (Hainmueller et al 2014), dplyr (Wickham and Grolemund 2017), nFactors (Raîche et al 2013), ggplot2 (Wickham 2009), lme4 (Bates et al 2015), effects (Fox and Hong 2009), GGthemes (Arnold 2017), tidyR (Wickham 2016), forcats (Wickham 2017) and texreg (Leifeld 2013).

Figure A2. Average rating of policy-packages by different sociodemographic characteristics. Note. The error bars display the 95%-confidence interval. For a test on statistical significances, see table A3.
Figure A3. Average rating of policy-packages by car dependence. Note. The y-axis displays the average conjoint rating per individual, the x-axis for graph A displays the answer to the question \( \text{How difficult would it be for you personally to completely stop driving a car?} \) This does not include the use of taxis/cabs and public transportation.\( \) and for graph B the answer to the question \( \text{Think of the past year: How many miles/kilometres did you drive by car (note: only as a driver, not as a passenger and regardless of whether you own this car or not)? If you do not know the exact number, please indicate your best estimate.} \)\( \). The error bars display the 95%-confidence interval.

Table A3. ANOVA test for significance of difference between means of sociodemographic characteristics.

|                      | Df | Sum Sq | Mean Sq | F value | Pr(>F) |
|----------------------|----|--------|---------|---------|--------|
| Gender               | 1  | 0.06   | 0.06    | 0.02    | 0.87   |
| Educ                 | 2  | 1638.82| 819.41  | 341.53  | <0.01  |
| Age                  | 1  | 911.21 | 911.21  | 379.79  | <0.01  |
| Incgrp               | 4  | 1238.06| 309.52  | 129.01  | <0.01  |
| Country              | 2  | 4431.56| 2215.78 | 923.54  | <0.01  |
| Gender:Country       | 2  | 232.92 | 116.46  | 48.54   | <0.01  |
| Educ:Country         | 4  | 206.21 | 51.55   | 21.49   | <0.01  |
| Age:Country          | 2  | 427.51 | 213.75  | 89.09   | <0.01  |
| Incgrp:Country       | 8  | 140.42 | 17.55   | 7.32    | <0.01  |
| Residuals            | 38 | 9811   | 252.34  | 2.4     |        |
Figure A4. Main results of conjoint experiment displaying Marginal Means with 95% confidence intervals for rating task; all countries pooled and separate.

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