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Are subsidies for climate action effective? Two case studies in the Netherlands

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ABSTRACT

An often used policy instrument to promote climate change mitigation and adaptation action are subsidies. Yet, it remains unclear to what extent subsidies are effective in motivating behavioural change. Subsidies are effective if they lead to adoption of the behaviour by individuals different from those who would adopt otherwise. On the bases of two theoretical frameworks, we examine the effectiveness of two subsidy schemes in the Netherlands. In Study 1 (n = 151), we applied the Transtheoretical Model and argued that a subsidy for climate adaptation measures is effective if it not only attracts those in the action and preparation stages of the model, but also people in the precontemplation and contemplation stage. In Study 2 (n = 367), we applied the Diffusion of Innovations Theory and argued that a subsidy for electric vehicles is effective if it attracts not only innovators and early adopters, but also early and late majority adopters. In both studies, we examined the extent to which subsidies remove financial barriers and serve as a cue to action. In Study 1, we found that the subsidies primarily attracted people who were in the action and preparation stages. In Study 2, we found that a subsidy for electric vehicles did not attract more early and late majority adopters compared to those who adopted an electric vehicle without a subsidy. In both studies we found that the subsidy mainly served as a cue to action, and was less likely to remove financial barriers.

Climate change is the most pressing issue of the 21st century. Global temperatures have already increased by 1° Celsius on average (IPCC, 2018). If global temperatures increase much further, the consequences will be innumerable and devastating: natural hazards such as heatwaves and floods will occur more frequently, sea levels will rise, vector-borne diseases will spread, and ecosystems will collapse (IPCC, 2018). Reducing CO_2 emissions and lowering the increase of global temperatures is therefore of critical importance. Moreover, since some degree of climate change is already inevitable, it is also necessary that societies adapt to the consequences of a changing climate. Governments are key players in mitigation (i.e., reducing CO_2 emission) (IPCC, 2018), and are starting to adapt to the consequences of climate change, too (European Environment Agency, 2020; Klein et al., 2018). Furthermore, governments can use policy instruments to promote climate action (i.e., actions aimed at either mitigating or adapting to the consequences of climate change) among industry and individual households as well (Henstra, 2016; Klein et al., 2018). In this paper, we focus on how governments can stimulate specifically individuals and households to take climate action.

Governments can use a variety of policy instruments to encourage individual citizens to take more climate action, such as legislation, taxation, and providing information (Henstra, 2016). One policy measure that is increasingly used to motivate behaviour is the subsidy: a conditional contribution towards the financial costs of mitigation or adaptation measures granted to individual citizens (Henstra, 2016). For example, subsidies are provided to encourage people to purchase solar panels and electric vehicles (Helveston et al., 2015; Simpson and Clifton, 2017). Increasingly, adaptation measures are also subsidized. For example, cities such as London, Chicago, and Rotterdam subsidize the instalment of green roofs (Mees et al., 2013). Also, in the UK, citizens that have previously been affected by flooding can apply for a subsidy to make their homes more resilient to flooding (Department for Communities and Local Government, 2017).

While subsidies have been implemented widely to encourage climate action, their effectiveness in promoting behavioural change is unclear. Financial incentives such as subsidies can be considered effective if they lead to adoption of behaviour by individuals different from those who would otherwise adopt the specific measure or behaviour (Rogers,

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2002). However, subsidies are ineffective if they mainly attract people who would also have taken the measures without the subsidy (Henstra, 2016). The effectiveness of a subsidy is therefore determined by its ability to tap into new groups of people that would not have taken the measures without the subsidy.

So far, the effectiveness of subsidies for motivating climate action has been tested empirically mostly on the macro level, meaning that their effectiveness is evaluated on the basis of tangible, aggregated outcomes, such as the number of solar panels installed in a region or the number of subsidies applied for. These studies report mixed findings regarding the effectiveness of subsidies (e.g., Matisoff and Johnson, 2017; Mees et al., 2013; Nicolini and Tavoni, 2017; Sierzchula et al., 2014). A drawback of such macro approaches is that it is somewhat of a black box: it is unknown what kind of people applied for the subsidy, and whether or how the subsidy actually encouraged people to take the specific climate-related action. It therefore remains unclear if the subsidy promoted adoption of the behaviour among those who would not have done so without the subsidy in place. To complement macro-level analyses of subsidies, we will adopt a psychological approach to studying the effectiveness of subsidies for climate action in the current paper. First, we will examine whether individuals who adopt subsidies were already likely to undertake the behaviour, or whether subsidies can also tap into a novel group of individuals who were not yet likely to undertake the behaviour. Second, we will also examine *why* the subsidy encouraged people to change their behaviour by examining whether subsidies are effective in reducing financial barriers.

1. Who applies for subsidies for climate action?

As argued above, a subsidy scheme is generally considered effective if it attracts a new group of people who would not have taken the measure without the subsidy (Rogers, 1962, 2002). To know whether a subsidy scheme is encouraging a new group of people, we need to understand what type of people apply for a subsidy scheme, and whether they were also likely to undertake the measure without the subsidy. Below, we introduce two theoretical frameworks, namely the Transtheoretical Model (Prochaska and Velicer, 1997) and Diffusion of Innovations Theory (Rogers, 1962, 2002), that can be used to inform us about who are applying for a subsidy scheme, and what this implies for the effectiveness of a subsidy scheme.

One way to study the effectiveness of subsidies is by using the Transtheoretical Model (Prochaska and Velicer, 1997). The Transtheoretical Model was originally developed in the domain of health psychology to study how people can be motivated to start and stick with healthy behaviours such as eating healthily and exercising (Prochaska and Velicer, 1997). The model proposes that when people (want to) change their behaviour, they progress through a series of distinct stages. The first stage is the precontemplation stage, where people are not aware that a behavioural change is needed, and have no plans to change behaviour. The next stage is the contemplation stage, where people have become aware that behavioural change is needed, and they contemplate behavioural change. The third stage is the preparation stage, where people are aware that a behavioural change is needed, and are actively preparing to change their behaviour. Finally, we have the action stage, where people actually start changing their behaviour.[2]

In case of subsidies, we may expect that people who are already in the preparation or action stage likely do not require an external incentive such as a subsidy, since they have already made the decision to take the measure (action stage) or are in the process of doing so (preparation stage). In other words, they likely would have taken the measures even if the subsidy was not offered. People in the precontemplation and contemplation stage are, on the other hand, not yet changing or planning to change their behaviour, and therefore form the key groups that a subsidy scheme should target in order to encourage more people to undertake climate action. Taken together, based on the Transtheoretical Model we propose that a subsidy for climate action is particularly effective if it attracts not only people in the action and preparation stages, but particularly people in the precontemplation and contemplation stages.

A second way to study the effectiveness of subsidies to adopt climate action is through the Diffusion of Innovations Theory. Subsidies are often provided for novel technological advances, such as solar panels, green roofs, and electric vehicles. Diffusion of Innovations Theory (Rogers, 1962, 2002) proposes that such technological advances are adopted by different groups in society at different rates. The first people to adopt innovations are the innovators, a group of risk takers who love technological advances. The innovators are promptly followed by the early adopters: high status trend-setters known to make smart decisions about new innovations. Next, the early majority will adopt the innovation once they see early adopters flaunting the advantages of the innovation. The final groups to adopt the innovation are the late majority, which adopts the innovation out of economic necessity and increasing social pressure, and the laggards, who hold limited resources to adopt innovations and are focussed on traditional values (Rogers, 2002).

We apply Diffusion of Innovations Theory to examine whether subsidies particularly attract people who were already likely to adopt the technology without the subsidy, or whether other groups adopted the technology that likely would not have taken the measure without the subsidy. For technological innovations such as electric vehicles, we expect that innovators and early adopters are already likely to adopt the innovation, and have the financial means to do so. Overall, these groups therefore likely do not need a subsidy scheme in order to adopt the innovation. Conversely, people who identify as early and late majority are less likely to adopt innovations and generally possess lower levels of disposable income than innovators and early adopters. The costs of adopting the sustainable technology could therefore represent a key barrier specifically for early and late majority adopters (Simpson and Clifton, 2017). Subsidy schemes reduce the costs of innovations, and could therefore be particularly important to promote the adoption of innovations among early and late majority adopters. Taken together, based on Diffusion of Innovations Theory we suggest that a subsidy is particularly effective if it attracts not only innovators and early adopters, but also early and late majority adopters.

2. Why does the subsidy motivate people?

In addition to the question *who* is applying for the subsidy, it is also critical to understand *why* the subsidy promotes climate action. By its design, the implementation of a subsidy assumes that people are already interested in taking the relevant climate action, but specifically the financial barrier is stopping them from undertaking climate action. The aim of the subsidy is then to remove that financial barrier. Indeed, we previously identified that a financial barrier may be particularly relevant for the early and late majority adopters. In the case of the Transtheoretical Model, it may also be the case that people in the early stages of the model are particularly hindered by the financial barrier. As such, the subsidy may be considered effective if people indicate that the subsidy takes away the financial barrier and thereby enables those in the later adoption phases and early stages from the Transtheoretical model to adopt the behaviour.

However, research suggests that subsidies for sustainable technologies often go to households with a high income (Andor et al., 2015; Macintosh and Wilkinson, 2011). In that case, the subsidy likely did not help individuals overcome financial barriers, as there are no financial barriers to start with. Instead, the subsidy may be more likely to function

[2] The Transtheoretical Model also has a fifth stage known as the 'maintenance stage', which consists of people who have maintained the behavioural change over a longer period of time (Prochaska and Velicer, 1997). We do not consider this stage in the current paper as the subsidy schemes we examine specifically focus on one-time behaviours that do not need to be continually maintained.

as a cue to action, that is, a trigger that can make people aware of or remind people of the specific climate action (Simpson and Clifton, 2017). Being made aware of or reminded of a specific climate action may in itself already encourage people to undertake this action, even without the financial incentive. For example, a study in the US found that most of the effect of a campaign to promote the uptake of solar panels was due to information, rather than due to a decrease in prices (Gillingham and Bollinger, 2021). A subsidy scheme may function similarly, and encourage people to adopt the behaviour because it serves as a reminder, or because it offers a financial windfall, rather than by actually removing financial barriers.

Disentangling the effects of a subsidy into removing financial barriers and a cue to action can have important practical implications. If a subsidy functions primarily as a cue to action, the provision of a financial incentive may not be necessary. In that case, more cost-effective campaigns could be developed that do not include a financial incentive but simply a reminder to adopt the behaviour. We will therefore examine to what extent a subsidy scheme primarily acts to remove the financial barriers, or whether the subsidy functions as a cue to action that can encourage people to undertake climate action.

3. The current research

To summarize, we will examine the extent to which subsidies encourage new groups of people to take climate action on the bases of two theoretical frameworks, namely the Transtheoretical Model and Diffusion of Innovations Theory. Moreover, we will examine to what extent a subsidy removes financial barriers, or alternatively functions as a cue to action. We will test these research questions in two case studies in the Netherlands. In Study 1, we will examine the effectiveness of a subsidy for climate change adaptation measures using the Transtheoretical Model. We will also examine whether people perceive the subsidy as a cue to action for specific stages of the Transtheoretical Model. In Study 2, we will examine the effectiveness of a subsidy for electric vehicles using Diffusion of Innovations Theory. To expand upon the findings of Study 1, we will compare subsidy applicants to people who did not apply for subsidy in this study based on Diffusion of Innovations Theory. We will again examine the extent to which the subsidy removes financial barriers and is perceived as a cue to action.

4. Study 1: Subsidy for climate change adaptation measures

4.1. Method

4.1.1. Participants and procedure

Participants were residents of a medium-sized city in the south of the Netherlands that had applied for a subsidy for climate change adaptation measures in the period from April 2020 (the start of the subsidy programme) to October 2020. Subsidy applicants were informed during their initial application that they may be invited to participate in a questionnaire study. A total of 269 people submitted a request for subsidy in the indicated period of 6 months, all of whom received an invitation from the municipality of the city to participate in an online questionnaire. Participants were contacted via the email address that they used to apply for the subsidy. A total of 151 participants filled out the questionnaire, a response rate of 56%. The questionnaire was completed in Enalyzer and took approximately 15–20 min to complete. The study was approved by the ethical committee of the University of Groningen. All participants provided their informed consent.

The majority of the respondents were men (70.1%) and their average age was 48 (SD = 12.96). With regard to the net monthly household income, 3 (2%) earned between €1.150 and €1.600, 7 (5%) earned between €1.600 and €2.150, 28 (21%) earned between €2.150 and €3.500, and 88 (66%) earned more than €3.500 per month (8 participants refused to answer (6%), 17 participants had missing data). Compared to the Dutch average, the income of our sample is high (CBS, 2019). We asked participants to indicate what the highest level of education is they completed. Seventeen participants did not indicate their educational level. Three participants had no or primary education (2%), 4 participants finished lower or higher secondary education (3%), 10 participants finished vocational school (8%), 78 participants finished applied science school (58%), and 39 participants finished university (29%). Compared to the general Dutch population the sample is highly educated (CBS, 2021).

4.2. Measures

Participants first reported for which type of climate adaptation measure(s) they had requested the subsidy. Participants could choose from the following options: rain barrel, water infiltration technologies, green roof, greening the (front) garden, or other. Importantly, the subsidy could only be applied for if people had already implemented the measure(s) or were in the process of doing so. The items mentioned below were then completed in reference to the specific measures people had implemented (or were in the process of implementing).

4.2.1. Transtheoretical model

Participants retroactively assessed in which stage their decision making was to implement the measure(s). They first read the following statement: '*When you first heard of the subsidy scheme, to what degree were you aware of and planning to take this/these specific measure(s)?*' Participants then selected one of the following four statements that assess the stages of the Transtheoretical Model and that best reflected their decision-making process at that time: (1) 'I was not aware of this/these measure(s)' (*precontemplation*) (2) I was aware of this/these measure(s), but did not plan on taking it/them yet (*contemplation*) (3) I was planning on taking this/these measure(s), but I had not yet taken concrete steps to execute this plan (*preparation*) (4) I was planning on taking this/these measure(s) and had already taken concrete steps to execute this plan (*action*) (Based on Gatersleben, 2003, Table 1). Respondents could also respond with 'I don't remember', but none of the participants selected this option.

4.2.2. Perception of the removal of financial barriers by the subsidy

To assess the extent to which people perceived that the subsidy removed the financial barrier to taking action, participants indicated on a 7-point scale (ranging from completely disagree to completely agree) their agreement with the following statement: 'Without the financial compensation of the subsidy, I would not have taken this/these measures(s)'.

4.2.3. Cue to action

We assessed to what extent the subsidy formed a cue to action for people to undertake the adaptation measures along the different stages of the Transtheoretical Model.

1) 'Because of the subsidy scheme, I became aware of this/these measure(s)' (reflecting a cue to action in the precontemplation stage).
2) 'Because of the subsidy scheme, I decided that I would take this/these measure(s)' (reflecting a cue to action in the contemplation stage).
3) 'Because of the subsidy scheme, I took concrete steps to implement this/these measure(s)' (reflecting a cue to action in the preparation stage).

All participants responded to each of these questions using a 7-point Likert scale ranging from 'completely disagree' to 'completely agree'. The higher the score on the item, the more people agreed that the subsidy formed a cue to action in that specific stage of the model.

5. Results and discussion

While the subsidy was available for a wide variety of climate

adaptive measures, most respondents applied for the subsidy to finance a green roof (78.8% of respondents). Most respondents classified themselves as being in the 'action' (45%) or 'preparation' (24.5%) stage of the Transtheoretical Model at the time of hearing about the subsidy scheme (see Fig. 1). A minority of respondents classified themselves as being in the 'contemplation' (7.3%) or 'precontemplation' stage (22.5%).

Approximately 25.9% of the respondents perceived that the subsidy removed a financial barrier, and agreed that they would not have taken the measure if the financial compensation of the subsidy was not provided (see Fig. 2). Interestingly, stronger agreement with this statement was not associated with the stage of the Transtheoretical Model that people assigned themselves to ($F(3, 143) = 1.36$, $p = .26$).

A majority of people agreed that the subsidy worked as a cue to action across all three stages of the Transtheoretical Model (see Fig. 2). The effect was however judged to be stronger for the preparation stage (the subsidy caused people to take concrete steps) compared to the precontemplation stage (the subsidy made people aware of adaptation measures) ($M_{preparation} = 4.93$, $SD_{preparation} = 2.02$, $M_{precontemplation} = 4.32$, $SD_{precontemplation} = 1.92$, paired $t(146) = 3.39$, $p = .001$) and the contemplation stage (the subsidy caused people to set intentions) ($M_{contemplation} = 4.55$, $SD_{contemplation} = 2.04$, paired $t(146) = 3.42$, $p = .001$). There was no difference in the mean scores on the cue to action for the precontemplation and contemplation stage (paired $t(146) = 1.49$, $p = .14$).

A paired sample t-test showed that people perceived the subsidy more as a cue to action, than that it removed financial barriers. This applied to the precontemplation stage ($M_{financial\ incentive} = 3.31$, $SD_{financial\ incentive} = 1.85$, paired $t(146) = 5.53$, $p < .001$), contemplation stage (paired $t(146) = 11.08$, $p < .001$), and preparation stage (paired $t(146) = 8.16$, $p < .001$).

We tested the correlations between the extent to which participants perceived the subsidy to remove key financial barriers and the extent to which it functioned as a cue to action. Perceiving that the subsidy removed key financial barriers was moderately strongly positive correlated with agreement that the subsidy functioned as a cue to action across the precontemplation ($r = 0.31$, $p < .001$), contemplation ($r = 0.55$, $p < .001$) and preparation stage ($r = 0.59$, $p < .001$). As shown in Fig. 3a-c, many people perceived the subsidy both as a cue to action and as removing a financial barrier (upper right quadrant). This suggests that some people thought that the subsidy formed a cue to action because of the financial incentive it provides. Yet, many people also perceived the subsidy as a cue to action, but not because it removed financial barriers for them (lower right quadrant). There were also people who thought the subsidy served neither as a cue to action nor as removing financial barriers (lower left quadrant). Lastly, there were very few people who perceived the subsidy as removing financial barriers, but not as a cue to action (upper left quadrant). That only a few people responded this way is explained by the fact that this response is logically implausible (perceiving the subsidy as removing financial barriers should be a cue to action for most people).

In conclusion, the subsidy scheme attracted primarily people who were already in the action or preparation stage, indicating that most of them were already motivated to undertake the measures. Still, a sizable minority of approximately 23% of participants indicated that they were in the precontemplation stage. The subsidy formed mainly a cue to action in the preparation stage, causing people to take concrete steps to take measures. The subsidy removed financial barriers to a lesser extent than functioning as a cue to action. The strength of the correlation between the perception of the removal of financial barriers by the subsidy and perceptions that the subsidy functioned as a cue to action was moderate. The scatterplots showed that for some people for whom the subsidy did not remove a financial barrier still agreed that the subsidy served as a cue to action for them. This indicates that the subsidy scheme also had a motivating effect beyond the financial incentive.

Importantly, our measure of the extent to which the subsidy removed a financial barrier could have been interpreted more broadly. Specifically, people could have interpreted it as the extent to which the subsidy simply motivated them to adopt the behaviour through a financial windfall, rather than specifically removing a financial barrier. Although we do not think that this is very likely, we will further explore this possibility in Study 2.

6. Study 2: Subsidy to promote the adoption of electric vehicles

The findings of Study 1 suggest that the subsidy mostly attracted those who were in the preparation and action stages, and were therefore already likely to adopt the behaviour. To a lesser extent, it also attracted those who were in the precontemplation and contemplation stages, and were therefore less likely to already adopt the behaviour. In Study 2 we aim to conceptually replicate these findings. However, this time we focus on a subsidy to promote the adoption of electric vehicles. Based on the Diffusion of Innovations Theory (Rogers, 1962, 2002), we will test if a subsidy for electric vehicles is likely to not only attract innovators and early adopters but also early and late majority adopters. Importantly, in this study we will also compare whether people who adopted an electric vehicle *with* a subsidy differ from those who purchased an electric vehicle *without* a subsidy. Specifically, we will test if those who adopted an electric vehicle with a subsidy are less likely to be innovators and early adopters and more likely to be early and late majority adopters

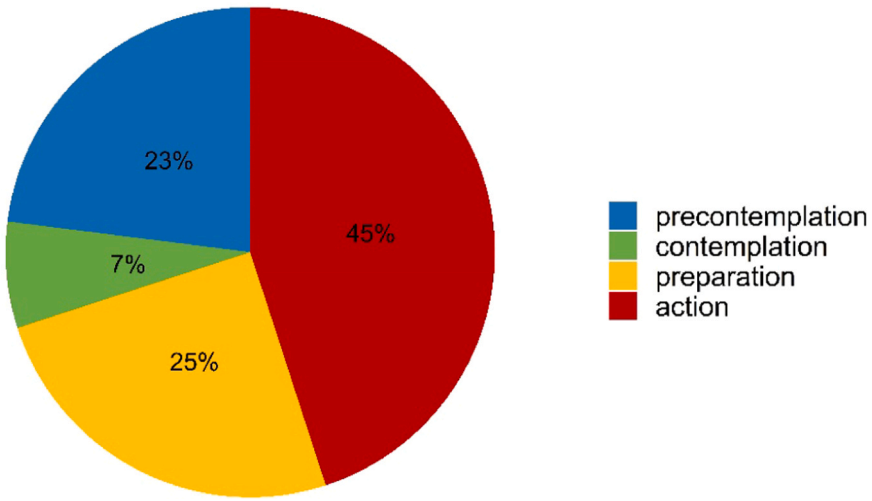

Fig. 1. Distribution of the respondents across the stages of the Transtheoretical Model.

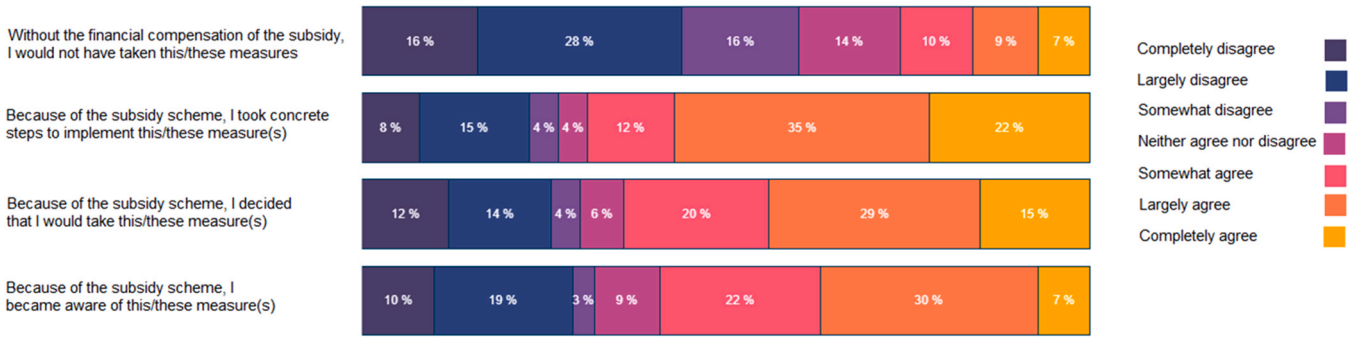

Fig. 2. Distribution of responses for questions about the subsidy alleviating financial barriers and functioning as a cue to action.

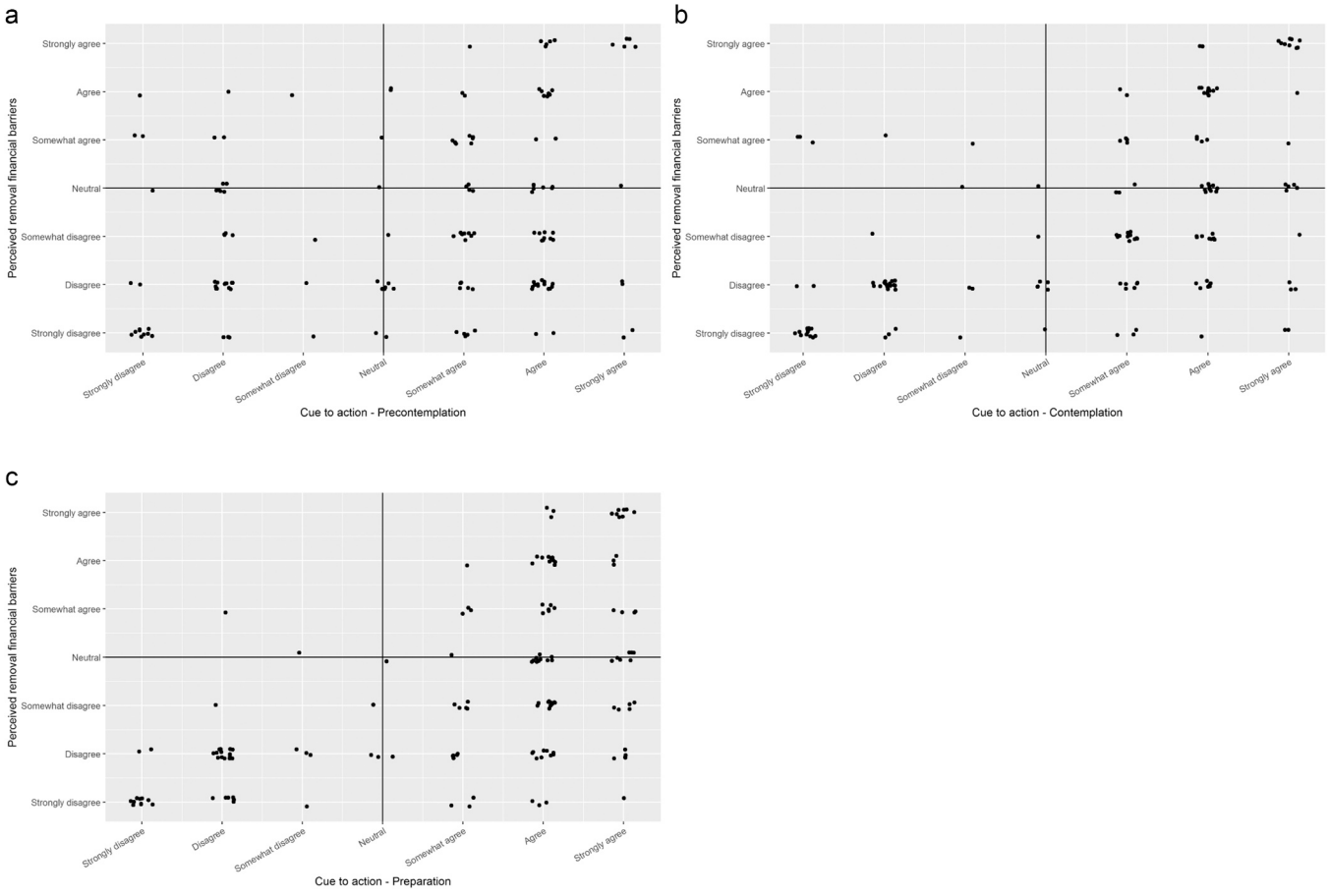

Fig. 3. Scatterplot showing the relationships in Study 1 between perceiving the subsidy as a cue to action in the precontemplation (3a), contemplation (3b), and preparation (3c) stages and perceiving the subsidy as removing a financial barrier. Note: points have been jittered slightly to avoid overlap and show the responses of all participants.

compared to those who adopted an electric vehicle without a subsidy. Lastly, we adjusted the measure examining whether the subsidies addressed financial barriers.

6.1. Method

The subsidy evaluated in Study 2 aimed to promote the adoption of electric vehicles. The subsidy was available for individuals who privately buy or lease a new or second hand full electric vehicle. The subsidy started on the first of July 2020 and runs until the 1st of July 2025. Those who buy or private lease a new full electric vehicle can receive 4.000 euros. In total, every year 10 million euros are available for subsidizing newly purchased vehicles. Those who buy or private lease a second hand full electric vehicle can receive 2000 euros. In total 7.2 million euros are available per year for subsidizing second hand vehicles. To be eligible for the subsidy, the price of the vehicle should be between 12.000 and 45.000 euros, and the range of the vehicle should be at least 120 kilometres.

6.1.1. Participants and procedure

The study was approved by the ethical committee of the University of Groningen. Participants were contacted by including the link to our questionnaire on several platforms for electric vehicle drivers in the Netherlands. In total 1712 electric vehicle drivers filled out the questionnaire. Participants first provided consent to participate in the study. Next, participants answered questions on their electric vehicle, followed

by questions on their reasons to adopt the electric vehicle, their experience with their electric vehicle and the adoption process including the questions on the subsidy. Finally, we asked questions on socio-demographic factors. We only included those who adopted a full electric vehicle privately in 2019 or later, leaving a sample of 367 participants. 135 participants received the subsidy, while 232 did not, and two did not answer this question. Most participants were male (331 participants, 90%). Only 33 participants were female (9%), and three participants did not indicate their gender (0%). Age ranged from 18 to 87 (M = 56, SD = 13.50). In total, 52 participants did not want to indicate their total gross annual household income (14%), 77 earned less than 40,000 euros (21%), 114 between 40,001 and 70,000 euros (31%), 87 between 70,001 and 110,000 (24%) and 37 more than 110,001 euros (10%). Compared to the Dutch average, the income of our sample is high (CBS, 2019). We asked participants to indicate what the highest level of education is they completed. Four participants did not indicate their educational level. Five participants had no or primary education (1%), 27 participants finished lower or higher secondary education (7%), 64 participants finished vocational school (17%), 175 participants finished applied science school (48%), and 92 participants finished university (25%). Compared to the general Dutch population the sample is highly educated (CBS, 2021).

6.2. Measures

6.2.1. Rogers' diffusion of innovations theory

We asked participants to classify themselves within Roger's theoretical framework by indicating which of the following five descriptions best described them (based on Noppers et al., 2015): 'I follow new technological developments and dare to take risks by being the first to adopt an electric vehicle' (*innovator)*, 'I am willing to be one of the first to adopt an electric vehicle. I do not mind if there are small limitations because the benefits outweigh the costs' (*early adopter*), 'I am pragmatic and take my time to be convinced of the benefits of an electric vehicle. My decisions are mainly based on the recommendations of current users' (*early majority*), 'I value convenience. I only adopt an electric vehicle when it is available for some time and clearly has advantages' (*late majority'*), 'I value stability, and only adopt an electric vehicle when the current model I drive is no longer available' (*laggard*).

6.2.2. Cue to action

We asked participants who received the subsidy to indicate to what extent they agree with the following statement: 'The subsidy scheme prompted me to adopt an electric vehicle' on a scale from 1 (totally disagree) to 5 (totally agree).

6.2.3. Perception of the removal of financial barriers by the subsidy

We asked participants who received the subsidy to indicate to what extent they agree with the following statement: 'Without the subsidy scheme I was not able to adopt an electric vehicle' on a scale from 1 (totally disagree) to 5 (totally agree).

7. Results and discussion

Across all participants, most identified as innovators (29%) or early adopters (58%). A minority identified as early majority (10%) or as late majority (2%). Only 1 participant identified as a laggard (0%). A chi-square test showed that the identification with different groups from Roger's typology did not differ across those who received the subsidy and those who did not receive a subsidy ($\chi^2(4, 367) = 3.84$, $p = .43$). The percentage of participants identifying as early majority was slightly higher among those who received a subsidy than among those who did not receive a subsidy, but this difference was not significant (see Fig. 4).

Of the respondents who received a subsidy, 25% agreed that the subsidy scheme removed a key financial barrier (i.e., they could not have purchased the electric vehicle without the subsidy scheme).

A paired sample t-test showed that the subsidy scheme functioned more as a cue to action ($M = 3.62$, $SD = 1.42$) than that it removed a financial barrier ($M = 2.56$, $SD = 1.43$; $t(132) = -7.96$, $p < .001$). We found that the more people perceived that the subsidy functioned as a cue to action the more they perceived that the subsidy removed a financial barrier ($r = 0.42$, $p < .001$). The effect size is medium to large (Cohen, 1992). This suggests that the effectiveness of the subsidy is partly explained by it removing the financial barriers, but not completely. Similar to Study 1, a scatterplot (Fig. 5) shows that there are people who agree that the subsidy functioned as cue to action, and that it removed a financial barrier (upper right quadrant). There are also people who do not agree that the subsidy removed a financial barrier, but still endorse that the subsidy functioned as a cue to action (lower right quadrant). Again, there are also people who think that the subsidy functioned neither as a cue to action, nor that it removed financial barriers (lower left quadrant). There are very few people that perceive that the subsidy did not function as a cue to action, but that do think that the subsidy removed financial barriers (upper left quadrant). Again, this response option represents a logical implausibility, which explains the low numbers of this response pattern.

In conclusion, the subsidy attracted mostly those who identify as innovator or early adopter. To a much lesser extent it also attracted those who identify as early or late majority. Moreover, when we compared the adopters with a subsidy to those who adopted an electric vehicle without a subsidy, we did not find any differences in the groups based on Roger's typology. The findings suggest that the subsidy did not particularly attract people who would otherwise not have adopted the

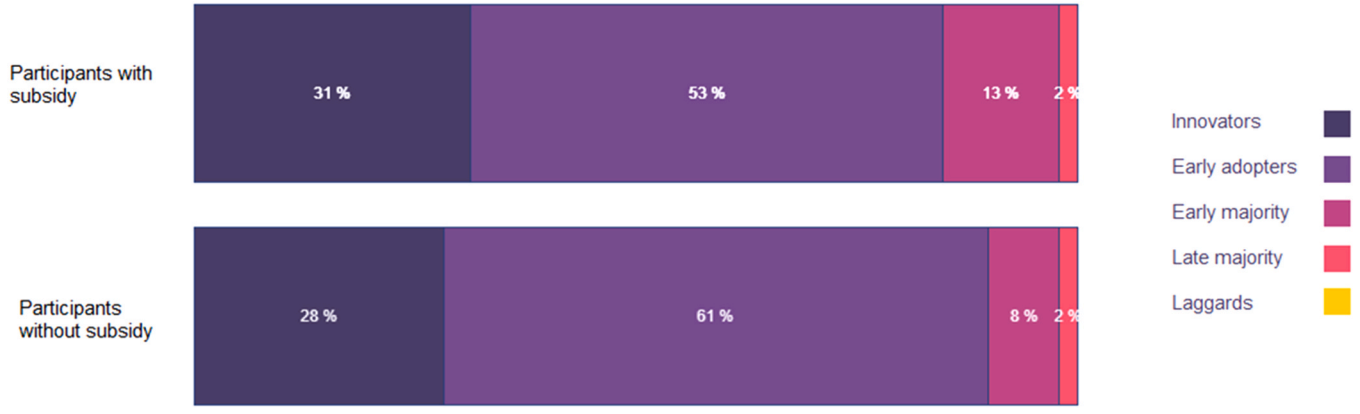

Fig. 4. Overview of the percentage of adopters based on Rogers' diffusion of innovations theory for participants who adopted an electric vehicle with and without a subsidy.

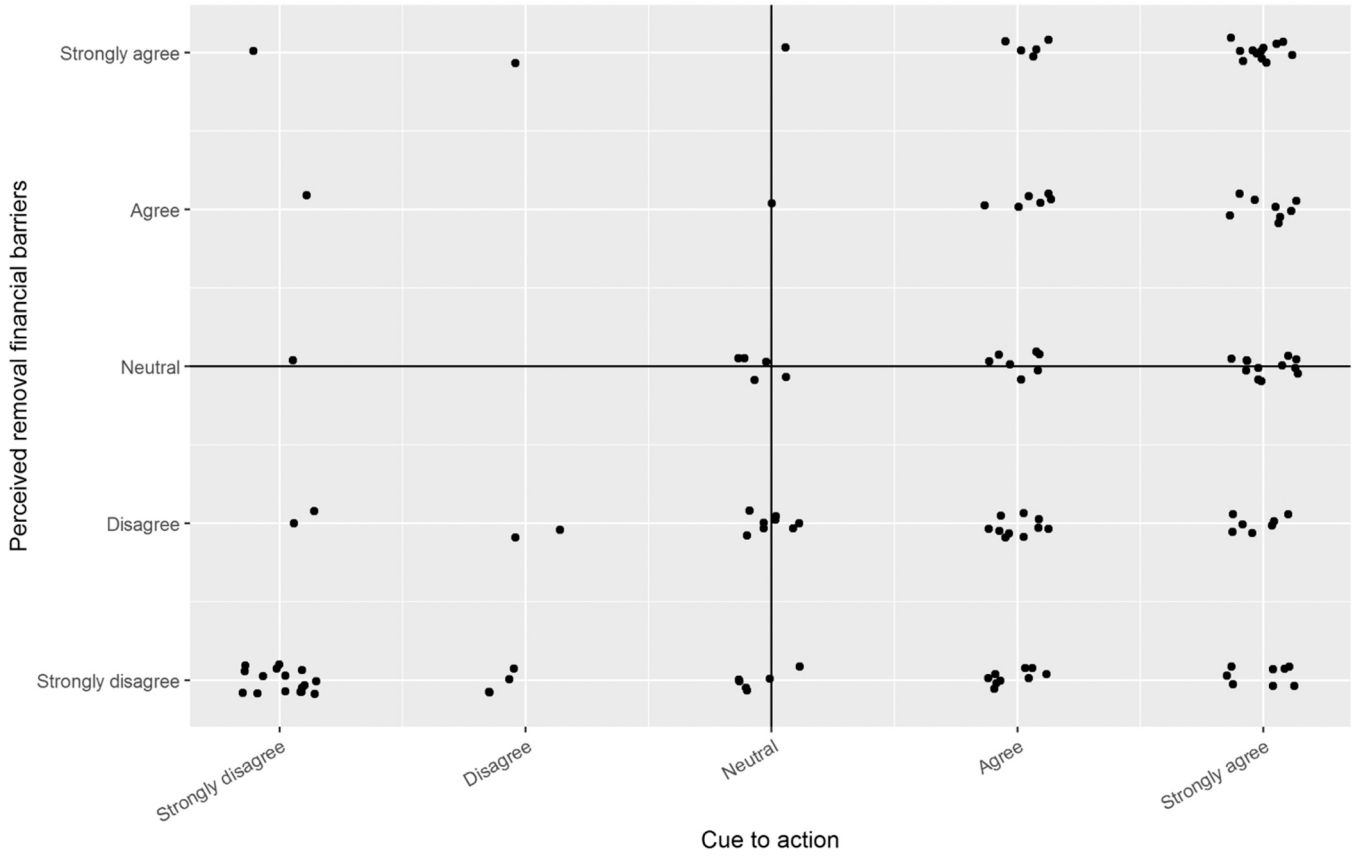

Fig. 5. Scatterplot showing the relationship in Study 2 between perceiving the subsidy as a cue to action and perceiving the subsidy as removing a financial barrier. Note: points have been jittered slightly to avoid overlap and show the responses of all participants.

electric vehicle. We found that people were more likely to perceive the subsidy as a cue to action than that it removed financial barriers. Furthermore, we found a positive relationship between the extent to which people perceive the subsidy as a cue to action and as removing barriers. Yet, the strength of the correlation was medium to large suggesting that the subsidy motivated people to adopt the behaviour beyond only financial aspects, which replicated the findings from Study 1.

8. Discussion

Climate change necessitates that people adopt a wide variety of actions to reduce their own carbon footprint or to adjust to the consequences of a changing climate. Governments are increasingly trying to motivate citizens to take climate action by implementing subsidies: a conditional contribution towards the financial costs of mitigation or adaptation measures granted to individual citizens (Henstra, 2016). We examined whether such subsidy schemes are actually effective in motivating a new group of people to take up climate action, or whether the subsidies are primarily received by people who would likely also have taken the measure(s) without a financial incentive. We did this by employing two psychological theories. In Study 1, we employed the Transtheoretical Model (Prochaska and Velicer, 1997), and we argued that a subsidy is likely to be effective if it not only attracts people from the action and preparation stages, but also people who were in the precontemplation and contemplation stages. In Study 2, we employed Diffusion of Innovations Theory (Rogers, 1962, 2002) and argued that a subsidy is likely to be effective if it not only attracts innovators and early adopters, but also the early and late majority. In both studies, we also examined whether the subsidy primarily motivates people by removing financial barriers, or whether a subsidy can also form a cue to action that motivates people by reminding them of specific climate actions.

Across both studies, we found that the subsidy scheme primarily attracted people who were already likely to undertake the climate actions in question. In Study 1, a large majority of respondents were already in the preparation or action stage before they heard about the subsidy. Similarly, in Study 2, most subsidy applicants self-identified as being innovators or early adopters. Moreover, we found no difference in Study 2 in the identification with Roger's typology groups between subsidy applicants and those who did not receive a subsidy, suggesting that the subsidy did not attract more people from specifically the early or late majority groups. Overall, these findings suggest that the subsidies schemes may not be effective in motivating a new group of people to take up climate measures.

However, our findings also suggest that the subsidies were still able to effectively promote climate action to at least some extent. For example, Study 1 found that a relatively large proportion of respondents (22.5%) indicated that they were not even contemplating implementing the climate measures before they heard about the subsidy, suggesting that the subsidy may have played a role in their decision making process. Moreover, we also found that 26% of respondents in Study 1 and 25% of respondents in Study 2 indicated that the subsidy removed a financial barrier, and that they would not have taken the measures without the subsidy scheme. In addition, Study 1 also found that perceiving the subsidy as removing financial barriers was not associated with the self-assessed stages of the Transtheoretical Model. This indicates that even people who were already in the preparation or action stage (and were therefore already highly motivated to take the measures) were still helped and motivated by the financial support offered by subsidy. These findings therefore show that, while most applicants for subsidies are people who were already likely to adopt the climate action, subsidy schemes can also attract new groups of applicants that would likely not

have considered taking the measures without the subsidy.

We also examined why the subsidy scheme motivated people to take adaptive measures. We found that many people agreed that the subsidy scheme functioned as a 'cue to action', that is, a trigger that can make people aware of or remind people of the specific climate action (Simpson and Clifton, 2017). We found that this could partially be explained by the fact that the subsidy removed a financial barrier. However, there were also people who agreed that the subsidy scheme functioned as a cue to action, but who did not indicate that financial barriers were removed. These findings are in line with previous research which shows that subsidies often go to households with a high income, suggesting that these households do not have strong financial barriers that need to be overcome (Andor et al., 2015; Macintosh and Wilkinson, 2011). Our findings show that subsidy schemes can have an effect beyond the financial incentive: they could for example make people aware of or remind people that there are particular measures they can take. The subsidy schemes could also indicate that these particular climate actions are deemed effective and relevant by (local) governments, which could motivate people more to undertake these measures. Future research is needed to test in what way subsidy schemes may function as a cue to action. A drawback of the current study is that we only asked people whether the subsidy removed a financial barrier. Yet, the financial incentive could also be perceived by people not as a necessary reimbursement removing barriers, but rather as a nice-to-have that is not essential. Yet, this could still mean people were motivated by the financial aspect of the subsidy. Importantly, the time limited nature of subsidy schemes could further strengthen this effect and encourage people to implement climate action now (Simpson and Clifton, 2017). Future studies could examine to what extent these other motives play a role in explaining the effectiveness of subsidy schemes in motivating people. Moreover, studies could examine whether interventions that simply remind people or bring specific measures to people's attention can be equally effective as subsidy schemes that offer financial incentives.

A methodological strength of our paper is that we focused on real life case studies of existing subsidy schemes, and included participants who were actually applicants of these subsidy schemes and who also implemented the relevant climate actions. This gives our research higher ecological validity compared to previous work that relies on hypothetical scenarios (DeShazo et al., 2017; Langbroek et al., 2016; Mundaca and Samahita, 2020). Yet, this also forms a key limitation of the current study, namely the fact that we could not control for the effects of the characteristics of the subsidy. For example, neither subsidy scheme that we examined reimbursed the entire expenses required to implement the specific measures. Given that a personal contribution of several hundred or thousand euros was still required to implement the measures, even if the subsidy was granted, this may still have excluded participants who face the largest financial barriers from applying for these subsidy schemes. Also, the subsidy also reimbursed costs, meaning that it required applicants to expend financial resources upfront. The high personal contribution and upfront costs could partly explain why we found that the subsidy schemes we studied mostly attracted applicants that were maybe already more capable of implementing these climate actions. The subsidy schemes we studied also attracted mostly people with a higher income, which is likely also because the subsidies did not fully reimburse the costs of adopting the measures and the upfront costs. Yet, the generally high income of the respondents could also (partly) explain why most participants did not feel that the subsidy scheme addressed financial barriers. Similarly, we could not account for possible administrative barriers that may have deterred people from applying for the subsidy. Another key characteristic that we could not control for is the extent to which the availability of the subsidy was widely known and advertised (cf. Zhang et al., 2013). In order to motivate a new group of people to undertake particular measures, it may be necessary to widely communicate about the availability of the subsidy and to make it very easy to apply for the subsidy. Overall, the findings reported in the current study may thus be partly attributable to the specific type of subsidy scheme that we examined. To maximise ecological validity and experimental control, future studies may examine the possibility of setting up experimental designs in collaboration with governments that systematically vary different characteristics of subsidy schemes, in order to examine how this influences their uptake amongst different groups in society.

Our findings have key practical implications. Our findings showed that subsidies primarily attract people who were already likely to implement the measure. In Study 2 we even found that people who applied for the subsidy did not differ from a control group that did not receive the subsidy. Still, many respondents found that the subsidy formed a cue to action (either due to the financial incentive or due to other, non-financial reasons). Even for people who were already likely to adopt the behaviour (e.g. those in the action or preparation stage), the subsidy therefore did prove to provide an extra push to motivate them to implement specific climate measures. As such, the subsidy schemes we examined in this study may particularly be useful to support and motivate citizens that are frontrunners, but other policy measures may be required to promote behaviour change among the public at large.

In conclusion, we studied the effectiveness of subsidies to motivate climate action in two case studies in the Netherlands. We found that the subsidies primarily attracted people who were already likely to undertake the specific measures. Still, many people found the subsidies to function as a cue to action, either due to the financial incentive or other reasons. As such, subsidy schemes seem particularly useful for supporting the group of frontrunners that are already motivated to undertake the measures, but less useful for motivating people at large who are not yet considering to take specific climate actions.

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CRediT authorship contribution statement

Anne van Valkengoed: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, Visualisation, **Ellen van der Werff**: Conceptualization, Methodology, Formal analysis, Investigation, Writing – original draft, funding acquisition.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

Andor, M., Frondel, M., Vance, C., 2015. Installing photovoltaics in Germany: a license to print money? Econ. Anal. Policy 48, 106–116. https://doi.org/10.1016/j.eap.2015.09.003.

CBS. (2019). *Inkomen, bestedingen en vermogen huishoudens; kerncijfers, NR* . ⟨https://opendata.cbs.nl/#/CBS/nl/dataset/84102NED/table?searchKeywords=bruto%20%20%20%20inkomen%20verdeling⟩.

CBS. (2021). *Bevolking; onderwijsniveau; geslacht, leeftijd en migratieachtergrond*. ⟨https://opendata.cbs.nl/statline/#/CBS/nl/dataset/82275NED/table?ts=1631624829260%C2%A0%C2%A0%C2%A0%C2%A0%C2%A0%C2%A0%C2%A0%C2%A0%C2%A0%C2%A0%20&fromstatweb=true⟩.

Cohen, J., 1992. A power primer. Psychol. Bull. 112 (1), 155–159.
Department for Communities and Local Government. (2017). *Flood recovery framework: Guidance for local authorities in England*.
DeShazo, J.R., Sheldon, T.L., Carson, R.T., 2017. Designing policy incentives for cleaner technologies: lessons from California's plug-in electric vehicle rebate program. J. Environ. Econ. Manag. 84, 18–43. https://doi.org/10.1016/j.jeem.2017.01.002.
European Environment Agency. (2020). *Monitoring and evaluation of national adaptation policies throughout the policy cycle.* Publications Office of the European Union. ⟨https://data.europa.eu/doi/10.2800/83221⟩.
Gatersleben, B., 2003. On yer bike for a healthy commute. In: Hendrickx, L., Jager, W., Steg, L. (Eds.), Human Decision Making and Environmental Perception: Understanding and Assisting Human Decision Making in Real-Life Settings. University of Groningen.
Gillingham, K.T., & Bollinger, B. (2021). Social Learning and Solar Photovoltaic Adoption. *Management Science*. ⟨https://doi.org/10.1287/mnsc.2020.3840⟩.
Helveston, J.P., Liu, Y., Feit, E.M., Fuchs, E., Klampfl, E., Michalek, J.J., 2015. Will subsidies drive electric vehicle adoption? Measuring consumer preferences in the U. S. and China. Transp. Res. Part A Policy Pract. 73, 96–112. https://doi.org/10.1016/j.tra.2015.01.002.
Henstra, D., 2016. The tools of climate adaptation policy: analysing instruments and instrument selection. Clim. Policy 16 (4), 496–521. https://doi.org/10.1080/14693062.2015.1015946.
IPCC. (2018). Global Warming of 1.5 °C. An IPCC special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. Intergovernmental Panel on Climate Change. ⟨https://www.ipcc.ch/sr15/⟩.
Klein, J., Araos, M., Karimo, A., Heikkinen, M., Ylä-Anttila, T., Juhola, S., 2018. The role of the private sector and citizens in urban climate change adaptation: evidence from a global assessment of large cities. Glob. Environ. Change 53, 127–136. https://doi.org/10.1016/j.gloenvcha.2018.09.012.
Langbroek, J.H.M., Franklin, J.P., Susilo, Y.O., 2016. The effect of policy incentives on electric vehicle adoption. Energy Policy 94, 94–103. https://doi.org/10.1016/j.enpol.2016.03.050.
Macintosh, A., Wilkinson, D., 2011. Searching for public benefits in solar subsidies: a case study on the Australian government's residential photovoltaic rebate program. Energy Policy 39 (6), 3199–3209. https://doi.org/10.1016/j.enpol.2011.03.007.
Matisoff, D.C., Johnson, E.P., 2017. The comparative effectiveness of residential solar incentives. Energy Policy 108, 44–54. https://doi.org/10.1016/j.enpol.2017.05.032.
Mees, H.L.P., Driessen, P.P.J., Runhaar, H.A.C., Stamatelos, J., 2013. Who governs climate adaptation? Getting green roofs for stormwater retention off the ground. J. Environ. Plan. Manag. 56 (6), 802–825. https://doi.org/10.1080/09640568.2012.706600.
Mundaca, L., Samahita, M., 2020. What drives home solar PV uptake? Subsidies, peer effects and visibility in Sweden. Energy Research & Social Science 60, 101319. https://doi.org/10.1016/j.erss.2019.101319.
Nicolini, M., Tavoni, M., 2017. Are renewable energy subsidies effective? Evidence from Europe. Renew. Sustain. Energy Rev. 74, 412–423. https://doi.org/10.1016/j.rser.2016.12.032.
Noppers, E.H., Keizer, K., Bockarjova, M., Steg, L., 2015. The adoption of sustainable innovations: the role of instrumental, environmental, and symbolic attributes for earlier and later adopters. J. Environ. Psychol. 44, 74–84. https://doi.org/10.1016/j.jenvp.2015.09.002.
Prochaska, J.O., Velicer, W.F., 1997. The transtheoretical model of health behavior change. Am. J. Health Promot. 12 (1), 38–48.
Rogers, E.M., 1962. The Diffusion of Innovations. Free Press.
Rogers, E.M., 2002. Diffusion of Innovations, 5th ed. Free Press.
Sierzchula, W., Bakker, S., Maat, K., van Wee, B., 2014. The influence of financial incentives and other socio-economic factors on electric vehicle adoption. Energy Policy 68, 183–194. https://doi.org/10.1016/j.enpol.2014.01.043.
Simpson, G., Clifton, J., 2017. Testing diffusion of innovations theory with data: financial incentives, early adopters, and distributed solar energy in Australia. Energy Res. Soc. Sci. 29, 12–22. https://doi.org/10.1016/j.erss.2017.04.005.
Zhang, X., Wang, K., Hao, Y., Fan, J.-L., Wei, Y.-M., 2013. The impact of government policy on preference for NEVs: The evidence from China. Energy Policy 61, 382–393. https://doi.org/10.1016/j.enpol.2013.06.114.