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Payment and policy consequentiality in dichotomous choice contingent valuation: Experimental design effects on self-reported perceptions

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Abstract: Although the contingent valuation literature emphasises the importance of controlling for respondents' consequentiality perceptions, this literature has rarely accounted for the difference between payment and policy consequentiality. We examine the influence of the randomly assigned tax amount on consequentiality self-reports and their potential endogeneity using data from a single dichotomous choice survey about reducing marine plastic pollution in Norway. Results show that consequentiality perceptions are a function of the tax amount, with payment consequentiality decreasing and policy consequentiality increasing with higher tax amounts. We discuss the challenge of finding valid instruments to address potential endogeneity of consequentiality perceptions.

Keywords: Contingent valuation, single dichotomous choice, payment consequentiality, policy consequentiality, endogeneity, marine plastic pollution

JEL codes: Q51

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1. Introduction

Incentive compatibility is a theory-based characteristic of contingent valuation survey design that assures truthful disclosure of preferences for non-market goods (Carson and Groves 2007). In an incentive compatible survey, it is in the respondent's best interest to truthfully reveal their preference for the good in question. The extent to which the survey is perceived by a respondent to be consequential, i.e. can potentially make a difference with respect to the decision whether to provide the good and collect the payment, has been identified as a precondition of incentive compatibility and hence of truthful preference revelation.[1] More precisely, consequentiality requires that survey respondents assign a positive probability that their responses will influence the decision whether to provide the good in question (so-called policy consequentiality) and that they will experience financial consequences of that decision (i.e. pay for the implemented outcome; so-called payment consequentiality) (Johnston et al. 2017). As such, consequentiality, embedded in the incentive compatibility concept, is a characteristic of the survey instrument and has been identified as a theoretical requirement for respondents to reveal their preferences truthfully in stated preference surveys (Carson and Groves 2007). However, deliberately inducing consequentiality via scripts in field surveys appears rarely successful (e.g. Czajkowski et al. 2017, Lloyd-Smith et al. 2019).[2] Hence, researchers often try to control consequentiality perceptions by eliciting them through follow-up questions in a survey and next including in preference modelling (e.g. Groothuis et al. 2017, Herriges et al. 2010, Zawojska et al. 2019).

Despite a considerable amount of research that uses elicited consequentiality beliefs, numerous issues remain unresolved, with perhaps the most challenging one being potential endogeneity of consequentiality perceptions. Endogeneity in this context has been understood in slightly different ways in the literature. Some studies examine whether consequentiality perceptions are endogenous by being a function of other, typically observed or somehow measurable characteristics of respondents, and hence such studies presume the perceptions might not be

[1] Further conditions for incentive compatibility of a survey concern the valuation question format, among others. A single dichotomous choice question is most straightforward to assure incentive compatibility, though upon satisfying additional design characteristics, other formats can be made incentive compatible too, such as a sequence of dichotomous choice questions (Vossler et al. 2012), payment card and open-ended questions (Vossler and Holladay 2018).

[2] We note, however, mixed evidence in this regard (e.g. Oehlmann and Meyerhoff 2017).

exogenous in the estimation of welfare measures such as willingness to pay (WTP). A number of studies investigate, for instance, whether socio-demographic variables affect both consequentiality perceptions and WTP responses (Needham and Hanley 2019, Oehlmann and Meyerhoff 2017, Vossler and Watson 2013). Other studies in this strand of literature examine the potential effect of elements of the survey experimental design on consequentiality perceptions. Yet, while Groothius et al. (2017) find that the randomly assigned tax amount in a single dichotomous choice contingent valuation survey on water conservation measures impacts on consequentiality perceptions, Lloyd-Smith et al. (2019) do not observe such an effect in a valuation study on increasing drinking water reliability. Following a second understanding of endogeneity, a small but growing number of studies suggest that responses to consequentiality and valuation questions may be both driven by the same unobservable factors (e.g. Groothuis et al. 2017, Herriges et al. 2010). This raises concerns around the validity of both statements on perceived consequentiality and welfare measures obtained from stated preference surveys incorporating consequentiality perception indicators without endogeneity controls. Although this can have important ramifications for preference modelling, research on endogeneity of consequentiality perceptions is limited and conclusions thus far are mixed. To clarify terms, the word endogeneity will be used only for the potential correlation of WTP and consequentiality responses with common unobservable factors in the remainder of the paper. To the investigation into the influence of the tax amount, we will more generally refer as identification of determinants of self-reported consequentiality perceptions. Examining the role of the tax amount for perceived consequentiality is the primary focus of this paper. A secondary goal of the paper is to study the potential endogeneity of consequentiality perceptions with respect to the WTP response in the empirical application.

Against this backdrop, this paper contributes to stated preference literature by assessing the influence of perceived consequentiality of the survey on the dichotomous choice WTP response. In addition, and more importantly, this paper examines the potential influence of a randomly assigned tax amount included in a single dichotomous choice contingent valuation question on self-reported consequentiality perceptions, while distinguishing between policy and payment consequentiality. The paper also explores possible endogeneity of self-reported consequentiality perceptions when used to explain WTP responses. The empirical case is a contingent valuation survey concerned with reducing marine plastic pollution in the Norwegian Arctic. Adding a new feature to the existing literature, the present study explicitly differentiates between payment and policy consequentiality. A trivariate probit model, with a set of socio-

demographic controls, shows that the effect of the randomly assigned tax amount on payment consequentiality is negative. This implies that respondents presented with a higher tax amount are less likely to believe that they will have to pay this amount once the policy is implemented, compared with respondents shown a lower tax amount. There is further evidence to suggest that the effect of the tax amount on policy consequentiality is positive, meaning that respondents faced with a valuation question with a higher tax amount are more likely to view the survey as related to actual policy consequences than those confronted with a lower tax amount. Possible mechanisms to explain these results are discussed. Results also indicate that both payment and policy consequentiality beliefs are endogenous to the binary WTP response, in the sense that the consequentiality perceptions and stated preferences seem to be driven by some unobservable factors.

The findings of our study add to the growing concern over the use of questionnaire items to assess consequentiality perceptions empirically (Lloyd-Smith et al. 2019). Perceived consequentiality questions have so far not been validated, and it is unclear if they can correctly capture respondents' beliefs on the intended issue. In addition to evidence as to the potential endogeneity of consequentiality perceptions with respect to dichotomous choice WTP responses, the effect of the variation of the tax amount on both payment and policy consequentiality is of concern. Nevertheless, we note that our findings can be context-specific.

Section 2 discusses related literature on eliciting consequentiality perceptions in valuation surveys, controlling for the perceptions in econometric models of stated preferences and the contribution of the present study. Section 3 introduces the survey instrument, dataset and the econometric model. Section 4 presents the results, and Section 5 provides final discussion of the findings and concludes.

2. Consequentiality perceptions in stated preference research

2.1. Perceived consequentiality in econometric models of stated preferences

The paper by Carson and Groves (2007) drew attention to the role of incentive compatibility of contingent valuation surveys for preference elicitation and inspired a substantial body of research, particularly, on survey consequentiality. In most applications of stated preference surveys in the field, meeting the requirement for consequentiality constitutes an important challenge. The likelihood of actual consequences of the survey outcome can often not be objectively defined and clearly communicated in the valuation scenario, and respondents are

likely to hold various views regarding this probability. To control such perceptions of respondents in preference modelling, researchers typically elicit the perceptions via questions of a type "To what extent do you believe that the voting results collected from you and other survey respondents will be taken into consideration by policy makers?", which respondents answer on a Likert scale (Lloyd-Smith et al. 2019, p. 296). Putting aside for a moment difficulties related to valid elicitation of consequentiality beliefs, another challenge is how to correctly incorporate the self-reported consequentiality perceptions in preference modelling. Consequentiality statements are likely subject to measurement error and potentially driven by similar factors as responses to valuation questions, which can cause endogeneity issues when perceived consequentiality indicators are used to explain stated preferences. Herriges et al. (2010) suggest that respondents assigning a high value to a considered environmental project may hold strong beliefs about the survey consequentiality as a result of the importance of the project to them. Indeed, many studies evidence that elicited WTP for goods or projects in question increase with the strength of the consequentiality belief (e.g. Forbes et al. 2015, Hwang et al. 2014, Li et al. 2018); though this evidence is not univocal (e.g. Oehlmann and Meyerhoff 2017, Vossler et al. 2012).

To the best of our knowledge, Herriges et al. (2010) is the first empirical study to address the potential confounding between preference modelling and perceived consequentiality. To disentangle the possible endogeneity effect, they use an exogenous information treatment, where half of the sample is presented an additional letter from a director of a governmental department and a related magazine article emphasising critical significance of the survey for deciding about the considered project. Results of their Bayesian treatment effect model point to endogeneity of consequentiality perceptions: the authors conclude that there exist unobserved characteristics that drive both consequentiality beliefs and WTP responses.

Several subsequent studies try to test the endogeneity conjecture by employing socio-demographic characteristics as instruments in preference modelling, but find consequentiality to be exogenous. For example, Vossler et al. (2012) use a generalised method of moments over-identification test. Similarly, Interis and Petrolia (2014) apply a test of over-identifying restrictions to results from a two-step instrumental variable probit model. Some studies that include consequentiality perceptions in preference modelling acknowledge a potential for endogeneity, but they do not have instruments sufficiently correlated with perceived consequentiality and uncorrelated with the error term in the outcome (utility/preference) function to explicitly examine the issue. For instance, to aid the lack of adequate instruments,

Vossler and Watson (2013) estimate several sample selection models and conjecture that results from their main model not addressing endogeneity should be robust to a model specification controlling endogeneity. This might imply limited importance of controlling for endogeneity of perceived consequentiality in econometric modelling of preferences. Needham and Hanley (2019) also do not find a good instrument for addressing the endogeneity concern, but they examine drivers of consequentiality perceptions, observing that, among a range of socio-demographic characteristics, mostly prior knowledge about the survey topic explains variation in consequentiality perceptions.

Groothuis et al. (2017) approach the problem of endogeneity of perceived consequentiality by hypothesising and empirically testing whether (elements of) the experimental design of a valuation question matters for consequentiality statements. Using data from a single dichotomous choice valuation survey, they find that with increases of the randomly assigned tax amount in the valuation question, respondents are less likely to view the survey as consequential. Further, their bivariate probit model of consequentiality and WTP reveals evidence of endogeneity: there seem to be some unobservable respondent characteristics that decrease the likelihood of voting for the considered public programme and strengthen the belief in the consequentiality of the survey at the same time.

Lloyd-Smith et al. (2019) also employ a single dichotomous choice format for preference elicitation and propose a novel special regressor approach to address possible endogeneity, which is a multistep estimator for the scaled probit model. Their findings evidence the importance of controlling for endogeneity of consequentiality responses in the modelling of stated preference responses. The special regressor estimates show that perceived consequentiality is not a statistically significant determinant of stated preferences, although a usual probit model, in which endogeneity is not accounted for, displays the opposite result. In contrast to Groothuis et al. (2017), Lloyd-Smith et al. (2019) observe no effect of the randomly allocated tax amount in the valuation question on consequentiality perceptions. Since the wording of the consequentiality-perception question in Groothuis et al. (2017) and Lloyd-Smith et al. (2019) is virtually identical, the findings regarding the influence of the tax amount are ambiguous and so far cannot be generalised. In a split-sample treatment comparison, Lloyd-Smith et al. (2019) further observe that the share of respondents who view the survey as inconsequential is higher if the consequentiality-perception question is asked after the valuation question than if asked before it. This opens a possibility that something else in the experimental design or wider valuation scenario other than the tax amount affects consequentiality

perceptions. We are not aware of any further studies which look at potential influences of experimental design components on consequentiality statements.

The econometric technique adopted by the present study follows the multivariate probit-based instrumental variable approach, employed in a similar way by Groothuis et al. (2017). We note, however, that other techniques have been used to examine and address the potential endogeneity of consequentiality perceptions, such as the special regressor approach suggested by Lloyd-Smith et al. (2019). For modelling stated preferences elicited with discrete choice experiment surveys and simultaneously accounting for potentially endogenous consequentiality perceptions, an extension to the hybrid choice model framework has been proposed by Budziński and Czajkowski (2018) (e.g. Budziński et al. 2019).

2.2. Distinguishing between payment and policy consequentiality

Although survey consequentiality is often seen as a general characteristic and, in line with that, consequentiality perceptions are usually elicited through a single question, a small number of studies have turned to an examination of distinctive roles of payment consequentiality and policy consequentiality for preference disclosure. The distinction between payment and policy consequentiality closely corresponds to a definition from recent guidelines for stated preference research, which describe consequentiality as a condition when a respondent views the probability to be positive "that their responses will influence decisions related to the outcome in question and they will be required to pay for that outcome if it is implemented" (Johnston et al. 2017, pp. 322-323). The former is often referred to as policy consequentiality; the latter is termed payment consequentiality (Herriges et al. 2010).

Mitani and Flores (2010, 2014) differentiate between these aspects of consequentiality in their theoretical models and in a laboratory induced-value experiment, both developed in the context of preference elicitation. They characterise conditions of payment and provision uncertainty, which can be translated into payment and policy consequentiality concepts in stated preference surveys. Probably the first study to take the differentiation between payment and policy consequentiality into the field is Zawojska et al. (2019). Employing a repeated multinomial choice valuation format, they find that policy consequentiality increases and payment consequentiality decreases WTP for renewable energy development options based on stated preference data from Poland. Their analysis shows further that the divergent effects of the two consequentiality components on WTP are driven by differential effects of the perceived

consequentiality on respondents' sensitivity to the monetary (cost) attribute of the considered project, with policy consequentiality decreasing and payment consequentiality increasing the cost sensitivity. We are not aware of any other valuation research that examines payment and policy consequentiality separately within a single study. In some field surveys, data on both payment and policy consequentiality were collected, though separate effects of these consequentiality aspects are not subsequently addressed in empirical analysis. For example, despite separately asking for payment and policy consequentiality perceptions, Oehlmann and Meyerhoff (2017) focus on policy consequentiality only, and Vossler and Holladay (2018) combine both consequentiality aspects into a single consequentiality indicator.

2.3 The contribution of the present study in the light of the reviewed literature

The present inquiry links the two areas of literature discussed above. To the best of our knowledge, these two areas have so far been treated separately in empirical research, namely the analysis of determinants and endogeneity of consequentiality self-reports have not been examined in studies that consider payment and policy consequentiality separately. This is a gap our study aims to fill. To this end, we adopt an approach that allows us to obtain data on respondents' perceptions of payment and policy consequentiality separately, and we further investigate a potential effect of the randomly assigned tax amount in the valuation question on each of the consequentiality components. We also try to address possible endogeneity of consequentiality perceptions in preference modelling by employing a trivariate probit approach.

In that way, our study seeks to extend the analysis by Groothuis et al. (2017) by differentiating between aspects of consequentiality. An assumption of the model in Groothuis et al. (2017) is that respondents believe that policy makers have sufficient power to coerce payment once the decision on implementation has been made. The concept of respondent-rated payment consequentiality relaxes this assumption, and previous empirical studies have sought to assess to what extent respondents perceive policy makers' power to impose payment obligation to be present (e.g. Oehlmann and Meyerhoff 2017, Zawojska et al. 2019) and the presented payment amounts to be credible (e.g. Champ et al. 2002, Flores and Strong 2007).

Groothuis et al. (2017) establish a link between the tax amount presented in the valuation question and perceived consequentiality of the survey responses by stating that higher tax amounts lead respondents to expect that the vote threshold is less likely to be met and that

therefore the perceived chances of their response to influence the decision of policy makers is reduced. However, this conceptual link does not distinguish between payment and policy consequentiality and whether these consequentiality components might be affected by the tax amount differently. Other studies have found that the credibility of the valuation scenario is affected by extreme tax amounts (Carson and Groves 2007). As a consequence, and if higher tax amounts indeed decrease the credibility of the cost of the valuation scenario, it can be conjectured that payment consequentiality is more likely to be affected by the tax amount than policy consequentiality. We therefore hypothesise that if perceived consequentiality is a function of the randomly assigned tax amount, it can be expected to affect payment consequentiality more (or exclusively) compared to policy consequentiality. To examine this relationship, the present study further develops the approach used by Groothuis et al. (2017) to apply it to single dichotomous contingent valuation data while differentiating between payment and policy consequentiality.

3. Methods

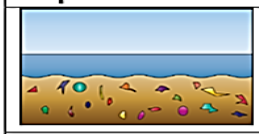
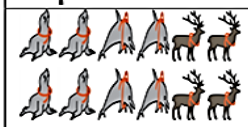
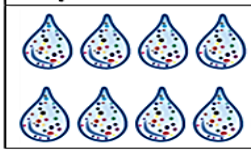
3.1. Survey and Dataset

The analysis uses data from a contingent valuation survey on marine plastics pollution in the Norwegian Arctic. Details about the survey development, structure, administration and policy context along with general results are provided in Abate et al. (2020). The good to be valued is a possible initiative by the Norwegian government to reduce marine plastic pollution in and around the archipelago of Svalbard. While being remote and sparsely populated, this Arctic archipelago has seen increasing levels of both macro (>5mm in size) and micro (0.1µm-5mm) plastic pollution on its shores and in the surrounding waters (e.g. Bergmann et al. 2016, Lusher et al. 2015). The impact of this type of pollution on ecosystem services delivery and associated human wellbeing is increasingly becoming clear (Beaumont et al. 2019). Therefore, the survey intended to assess the expected welfare change resulting from the (partial) removal of this type of plastics pollution in the Artic coastal and marine environment, using Svalbard as a case study.

The survey informs respondents that the proposed initiative would include measures such as a marine plastic litter awareness campaign; improved regulation of plastic use by maritime sectors in the area; improvement of water treatment facilities to reduce the emission of microplastics; a national ban on cosmetics containing microbeads; and regular cleaning of

shorelines and beaches in Svalbard. Respondents are told that these measures would lead to improvements in four key environmental indicators, namely the amount of plastic litter found along shorelines in the archipelago; the annual number of marine mammals entangled in plastic litter; the share of seabirds with plastic pieces in their stomachs; and the concentration of microplastic in the waters around Svalbard. The baseline and improvement levels of the four indicators were derived from the literature on the current status and impacts of marine plastic pollution in the Norwegian Arctic (Bergmann et al. 2017, Lusher 2015, Trevail et al. 2015). Figure 1 displays the baseline and improvement levels of the indicators. These are a translation from the original Norwegian as presented in the questionnaire.[3] The indicators were originally developed for a discrete choice experiment. However, responses to pilot surveys indicated that respondents perceived the presented improvements as a package, so we decided to assess the value of this set of improvements using a single dichotomous choice format (Abate et al. 2020).

Figure 1: Baseline and improvement levels of marine plastic pollution indicators as described in the questionnaire (translation from the Norwegian original)

Impacts of marine plastic litter around Svalbard	**Current situation**	**With the initiative**
Impact on beaches		
	**100** grams of plastics per meter square of beach	**10** grams of plastics per meter square of beach
Impact on mammals		
	**60** seals, reindeer, or porpoises get entangled in nets and ropes	**10** seals, reindeer, or porpoises get entangled in nets and ropes
Impact on birds		
	**90%** of seabirds have pieces of plastic in the stomachs	**10%** of seabirds have pieces of plastic in the stomachs
Impact on microplastics		
	**90%** of water samples contain microplastics	**10%** of water samples contain microplastics

[3] The questionnaire will be made available online upon the paper publication.

Following the description of this public policy project, the preference elicitation question is asked to assess WTP for this initiative. The payment vehicle is an annual household tax payable by all households in Norway, including Svalbard, for the duration of the initiative (10 years). To each respondent, one tax amount in Norwegian Kroner (NOK) from the vector [500; 1,500; 2,700; 4,400; 7,000] is randomly assigned. Given the assigned tax amount, a respondent is asked to indicate whether they would vote in favour of or against the initiative. In this way, the valuation question mirrors public referendum voting (a "fundamental" guideline for environmental value elicitation; Johnston et al. 2017, p. 322). This provision point mechanism was selected because of the binding nature of the payment in case of implementation and in order to convey that respondents' answers would influence the provision decision of the proposed benefits (Johnston et al. 2017). The single dichotomous choice valuation question reads as follows[4] (with the randomly assigned tax amount displayed in place of ___ below)[5]:

> Considering the anticipated results of the initiative outlined above, would you vote for this initiative if the initiative would cost your household an annual tax of NOK ___ for the next ten years?
>
> ❑ Yes, I would vote for the initiative if it costs my household NOK ___ per year.
>
> ❑ No, I would not vote for the initiative if it costs my household NOK ___ per year.

Consequentiality perceptions are measured using two attitudinal statements with a 5-point agree/disagree (Likert) response scale. The statements appear in the survey questionnaire soon after the valuation question. The exact wordings of the statements and of response categories are reported in Table 1, together with a cross-tabulation of frequencies of responses to these statements. The formulation of the payment consequentiality statement (PAY) is contingent on the tax amount which is inserted at the end of the sentence: "… the tax of NOK ___". The wording of the policy consequentiality statement (POL) is identical for all tax amounts. Table

[4] Text is the English translation from the Norwegian original.

[5] A 'no-answer / don't know' response option was not provided in this format to incentivise respondents to provide a definite answer regarding their WTP. Carson et al. (1998), for instance, show that undecided respondents would vote 'No' in situations where a 'Don't know' option is not provided.

1 reveals that with respect to both consequentiality statements, the most frequent responses are "Neither agree nor disagree" (47% for both), followed by "Agree" (30% and 24% for PAY and POL, respectively). In general, more respondents expressed at least some agreement with the statements than disagreement. Responses to the two consequentiality measures are moderately correlated as indicated by Spearman's rank order correlation coefficient of $r_s = .214$ ($p < .001$).

Table 1: Response frequencies to consequentiality statements

		POL: "My responses to this survey will have an influence on whether this initiative is implemented"						
		1 (SD)	**2 (D)**	**3 (N)**	**4 (A)**	**5 (SA)**	**Total**	
PAY: "If the government carries out this initiative, I believe that I will be charged the tax of NOK ___"	**1 (SD)**	4	4	3	2	0	13	2%
	2 (D)	11	17	25	14	3	70	13%
	3 (N)	18	44	150	41	5	258	47%
	4 (A)	7	24	67	66	4	168	30%
	5 (SA)	5	7	13	12	6	43	8%
	Total	45	96	258	135	18	552	100%
		8%	17%	47%	24%	3%	100%	

Notes: PAY denotes a payment consequentiality statement, POL denotes a policy consequentiality statement. "___" is the respective tax amount a respondent saw in the valuation question. SD - strongly disagree; D - disagree; N - Neither agree nor disagree; A - Agree; SA - Strongly agree. Questionnaire items are a translation from the Norwegian original.

This survey instrument was developed through an extensive testing procedure (as recommended by stated preference research guidelines in Johnston et al. 2017) which involved thorough literature review and expert consultations regarding the impact of marine plastics in the Arctic; three focus groups in Svalbard with residents, students and staff of the local University Centre, and tourists, and one focus group in Tromsø on the Norwegian mainland with members of the public. The total number of focus group participants was 28 across all four meetings. Subsequently, we conducted three pilot surveys (of which two were online), each with $N = 50$. As detailed in Abate et al. (2020), we abandoned original plans for using a choice experiment approach after two pilots because respondents interpreted the proposed improvements as one package. Instead, we employed the single dichotomous choice format.

The main survey was implemented online by the market research firm Norstat in June 2018 using a panel which covers a sample of Norwegian households, including households on Svalbard. An invitation to participate in the survey was sent to 10,447 respondents in the panel. 1,804 completed responses were obtained across three treatments which slightly varied the valuation question. Responses from only the single dichotomous choice treatment are used for

the analysis here. This treatment sample contained 600 completed questionnaires, of which 48 were discarded as protest responses,[6] leaving a useable dataset of $N = 552$ for this study. The analysis presented in the following is based on the dataset without protesters, however, the same models were performed using the dataset which includes protesters. All findings below are confirmed by models employing that larger dataset (with $N = 600$).

3.2. Model estimation

The first part of our analysis employs a series of binary and ordered probit models to identify factors influencing responses to both the valuation question and the statements of perceived consequentiality. We provide no formal introduction into these well-known models here. In the next part, to examine the potential endogeneity of consequentiality perceptions, we apply an instrumental variable approach based on a trivariate probit model. The model consists of three equations, which can be formally expressed as follows:

$$\begin{aligned} &\text{Equation 1 (payment consequentiality equation):} && y_1^* = \beta_1' \boldsymbol{x_1} + \gamma_1 \boldsymbol{z} + \epsilon_1 \\ &\text{Equation 2 (policy consequentiality equation):} && y_2^* = \beta_2' \boldsymbol{x_2} + \gamma_2 \boldsymbol{z} + \epsilon_2 \\ &\text{Equation 3 (voting equation):} && y_3^* = \beta_3' \boldsymbol{x_3} + \delta_1 y_1 + \delta_2 y_2 + \epsilon_3 \end{aligned} \tag{1}$$

$$y_1 = \begin{cases} 1 \;\; if \; y_1^* > 0 \\ 0 \;\; otherwise \end{cases}, \quad y_2 = \begin{cases} 1 \;\; if \; y_2^* > 0 \\ 0 \;\; otherwise \end{cases}, \quad y_3 = \begin{cases} 1 \;\; if \; y_3^* > 0 \\ 0 \;\; otherwise \end{cases}. \tag{2}$$

According to (2), for latent variables y_1^*, y_2^* and y_3^* representing unobservable policy and payment consequentiality beliefs and WTP for the proposed initiative, respectively, only binary indicator variables y_1, y_2 and y_3 are observed. The indicator variables are derived from corresponding consequentiality statements for y_1 and y_2 (i.e. PAY and POL) and from responses to the single dichotomous choice valuation question for y_3, as described in the preceding section. In equation (1), $\boldsymbol{x_1}$, $\boldsymbol{x_2}$ and $\boldsymbol{x_3}$ are vectors of exogenous variables, and β_1, β_2 and β_3 are their respective coefficient vectors to be estimated. Note that $\boldsymbol{x_1}$, $\boldsymbol{x_2}$ and $\boldsymbol{x_3}$ can overlap, and indeed the subsequent analysis will use these vectors with the same set of regressors. δ_1 and δ_2 are scalar coefficients of the indicator variables which enter the voting

[6] Identified as protestors were respondents who answered 'No' to the valuation question and agreed or strongly agreed to both the statements "I already pay enough in taxes" and "I have the right to have well preserved marine environments and I should not have to pay extra for it".

equation as additional explanatory variables (i.e. policy and payment consequentiality beliefs). To identify the model, a vector $\boldsymbol{z}$ of instrumental variables is included in equations 1 and 2 (Wilde 2000). If only one instrumental variable is employed, $\boldsymbol{z}$ has only one element, but in the case of our study, $\boldsymbol{z}$ contains two instrumental variables. In general applications, the instruments used in equations 1 and 2 can differ, but we use the same set of instruments for both payment and policy consequentiality. The elements of $\boldsymbol{z}$ are further required to be uncorrelated with the error term of the voting equation ϵ_3, but correlated with the instrumented variables y_1 and y_2, respectively. The choice of instrument and the extent to which results hinge on this choice are discussed in the Results section. γ_1 and γ_2 are coefficient vectors of the instrumental variables in equations 1 and 2, respectively.

The error terms in (1), ϵ_1, ϵ_2 and ϵ_3, are assumed to follow a trivariate normal distribution with mean $[0\ \ 0\ \ 0]$ and variance $[1\ \ 1\ \ 1]$. The coefficients $\beta_1, \beta_2, \beta_3, \gamma_1, \gamma_2, \delta_1$ and δ_2 are estimated using the maximum likelihood method. In addition, the correlation coefficients between the three error terms are calculated and could be represented in the form of the matrix in (3), with ρ_{ij} denoting the correlation of error terms from equations i and j, where $i = \{vote, pay, pol\}$ and $j = \{vote, pay, pol\}$ and $\rho_{ij} = \rho_{ji}$.

$$\mathrm{P} = \begin{pmatrix} 1 & \rho_{pay,vote} & \rho_{pol,vote} \\ \rho_{vote,pay} & 1 & \rho_{pol,pay} \\ \rho_{vote,pol} & \rho_{pay,pol} & 1 \end{pmatrix} \tag{3}$$

If the null hypothesis of $\rho_{vote,pay} = 0$ cannot be rejected, y_1 is exogenous in the voting equation in (1). Similarly, if $\rho_{vote,pol} = 0$ cannot be rejected, y_2 is exogenous in the voting equation. If either of these correlation estimates differs from zero, there is a common correlation with unobservables in the voting equation and the respective consequentiality equation. $\rho_{pay,pol} = \rho_{pol,pay}$ is the correlation coefficient between the error terms of equations 1 and 2, i.e. payment and policy consequentiality and is estimated to control for the correlation between the two indicators (see Table 1).

This specification of the trivariate probit model allows us to simultaneously assess the effect of payment and policy consequentiality perceptions on valuation question responses in the voting equation. At the same time, the model helps us understand the influence of observable characteristics on consequentiality self-reports, including the randomly assigned tax amount, in the payment and policy consequentiality equations. This instrumental variable approach also allows us to address potential endogeneity issues.

4. Results

Table 2 lists the variables to be used in the subsequent regression models and reports descriptive statistics for these variables. In addition to the variables TAX, MALE and AGE, UNIVERSITY is a binary variable indicating whether a respondent has obtained a university degree. BEEN is a binary variable assessing whether a respondent has ever visited or lived in Svalbard. INCOME is the actual household income variable (in NOK 1,000) collected through a set of income intervals. Midpoints of these intervals are used in the analysis. Missing income statements were imputed using the sample mean of 790.95 (in 1,000 NOK). The variable NO_INC is a dummy variable indicating that a respondent did not state their household income. The variables PAY and POL are consequentiality indicators and assess agreement (on 5-point Likert scales) to the statements "If the government carries out this initiative, I believe that I will be charged the tax of ___" and "My responses to this survey will have an influence on whether this initiative is implemented", respectively. DECISIONS and ACTIONS are dummy variables indicating agreement with the statements "My decisions and behaviour can help reduce marine plastics litter" and "My personal actions do NOT play a significant role in the health of the marine environment", respectively. We use these variables as instruments for both the policy and payment consequentiality variables.

Table 2: Sample characteristics

Variable	Explanation	Measurement	Mean	Std. dev.	Min.	Max.
TAX	Tax amount	NOK 1,000	3.22	2.30	0.5	7
MALE	Respondent is male	1 = male, 0 = female	0.51	0.50	0	1
AGE	Respondent's age	Years / 100	0.45	0.17	0.18	0.84
CHILD	Respondent has children	1 = yes, 0 = no	0.57	0.50	0	1
UNIVERSITY	Respondent has university degree or above	1 = yes, 0 = no	0.62	0.49	0	1
BEEN	Respondent has been to Svalbard	1 = yes, 0 = no	0.13	0.34	0	1
INCOME	Household income	NOK 1,000	790.95	368.83	100	2,000
NO_INC	Respondent did not state income	1 = yes, 0 = no	0.24	0.43	0	1
PAY	"If the government carries out this initiative, I believe that I will be charged the tax of NOK ___"	5-point agreement scale; 1 = strongly disagree, 5 = strongly agree	3.29	0.87	1	5
POL	"My responses to this survey will have an influence on whether this initiative is implemented"	5-point agreement scale; 1 = strongly disagree, 5 = strongly agree	2.97	0.94	1	5
DECISIONS (IV)	"My decisions and behaviour can help reduce marine plastics litter"	1 = agree, 0 = disagree	0.83	0.31	0	1
ACTIONS (IV)	"My personal actions do NOT play a significant role in the health of the marine environment"	1 = agree, 0 = disagree	0.06	0.24	0	1

Notes: N=552. For INCOME, the sample mean of NOK 790.95 was imputed for the 132 respondents who did not state their income.

The analysis in the next section examines the potential effect of the randomly allocated tax amount on stated consequentiality perceptions, among other possible determinants of the perceptions. Subsequently, Section 4.2 provides results of the trivariate probit model, allowing us to simultaneously draw conclusions about the effects of the determinants of consequentiality measures and their endogeneity, while controlling for possible correlation between the two indicators of separate consequentiality components.

4.1. Indicative determinants of consequentiality perceptions

The starting point of the analysis is an investigation into determinants of consequentiality perceptions with a particular focus on the effect of the randomly assigned tax amount. To this end, we use a set of ordered and binary probit models with variables PAY and POL, and their binary alterations, as dependent variables. For the purpose of these models, the levels of PAY and POL are used as introduced in Table 1 with 1 denoting the weakest / lack of consequentiality belief and 5 representing the strongest consequentiality belief. Results of this analysis are presented in Table 3, with Models 1 and 2 explaining payment consequentiality responses through ordered and binary probit regressions, respectively, and Models 3 and 4 explaining policy consequentiality responses through ordered and binary probit regressions, respectively. Model 1 reveals that the coefficient of the tax amount (TAX) is negative and significant, indicating that higher tax amounts are associated with weaker perceived payment consequentiality. This relationship cannot be found in an equivalent ordered probit model of policy consequentiality (Model 3). In the ordered probit model of payment consequentiality, the only effect of a socio-demographic variable is the negative effect of household income indicating that higher-income respondents are less likely to expect to have to pay the proposed amount (Model 1). In the corresponding ordered probit model of policy consequentiality (Model 3), only respondent age (AGE and age squared – AGE2) statistically significantly explains the perceptions, with increasing age first weakening and then strengthening the perceived consequentiality. Other socio-demographic variables are not associated with the systematic variations in consequentiality perceptions in these ordered probit models.

Models 2 and 4 in Table 3 are probit models of binary indicators of payment and policy consequentiality perceptions. The binary indicators are transformations of the 5-point Likert responses into binary consequentiality variables. It is necessary to re-code the ordered consequentiality variables PAY and POL into binary indicators for using the trivariate probit

approach, which allows for controlling for potential endogeneity. For creating a binary indicator, the question about the cut-off point is essential. Given the 5-point Likert response scale employed in the survey, a cut-off between "Disagree" and "Neither agree nor disagree" answers is used. This selection follows the theory-based conclusion by Carson and Groves (2007), later referred to as a "knife-edge" result (Herriges et al. 2010). The "knife-edge" result implies that for truthful revelation of preferences, it is sufficient that a survey is perceived at least as marginally consequential, and there should be no significant difference in preferences disclosed by respondents varying in the strength of their consequentiality belief as long as they perceive at least some positive probability of actual consequences of the survey outcome.[7] Therefore, with this binary indicator, our analysis distinguishes between those who (may) hold some belief of the consequentiality of the survey (demonstrated by responses "Strongly agree", "Agree" and "Neither agree nor disagree" to consequentiality statements) from those who express no belief in consequentiality (by responding "Strongly disagree" or "Disagree" to consequentiality statements). These binary variables are denoted PAY > 2 for payment and POL > 2 for policy consequentiality.

Table 3: Ordered and binary probit models of payment and policy consequentiality

	Mo 1: Ordered probit DV = PAY (5-point)		**Model 2: Binary probit DV = (PAY > 2)**		**Model 3: Ordered probit DV = POL (5-point)**		**Model 4: Binary probit DV = (POL > 2)**	
	Coef.	**Std. Err.**	**Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**	**Coef.**	**Std. Err.**
TAX	-0.046**	(0.020)	-0.092***	(0.028)	0.020	(0.020)	0.060**	(0.026)
MALE	-0.025	(0.093)	-0.211	(0.137)	0.017	(0.093)	-0.070	(0.121)
AGE	-1.807	(1.751)	-2.683	(2.679)	-3.445**	(1.747)	-4.091*	(2.349)
AGE2	1.410	(1.758)	2.520	(2.702)	3.479**	(1.754)	4.729**	(2.371)
CHILD	0.023	(0.113)	0.125	(0.164)	-0.113	(0.113)	-0.199	(0.146)
UNIVERSITY	-0.039	(0.098)	0.071	(0.143)	0.006	(0.097)	0.106	(0.126)
BEEN	-0.019	(0.138)	0.055	(0.201)	0.036	(0.137)	0.018	(0.177)
INCOME	-0.293**	(0.134)	-0.206	(0.189)	-0.118	(0.134)	-0.265	(0.171)
NO_INC	-0.067	(0.110)	0.116	(0.167)	-0.068	(0.109)	-0.054	(0.142)
/cut1	-2.937	(0.395)			-2.251	(0.380)		
/cut2	-1.962	(0.379)			-1.503	(0.376)		
/cut3	-0.602	(0.373)			-0.238	(0.372)		
/cut4	0.535	(0.375)			1.025	(0.377)		
CONSTANT			2.116***	(0.575)			1.536***	(0.501)
Log-likelihood	-690		-224		-723		-304	
Number of parameters	13		10		13		10	
BIC	1,462		512		1,528		672	

Notes: N=552. DV – dependent variable. ***, ** and * indicate the 1%-, 5%- and 10%-level of significance, respectively. INCOME is in NOK 1,000. The sample mean of NOK 790.95 was imputed for the 132 respondents who did not state their income.

[7] The evidence is mixed whether the "knife-edge" result holds in empirical data. Some studies report that WTP depends on the degree of consequentiality belief (e.g. Interis and Petrolia 2014, Vossler et al. 2012).

Results of the binary probit models indicate that higher tax amounts are associated with weaker payment consequentiality perceptions (Model 2) and stronger policy consequentiality perceptions (Model 4). Regarding the influence of socio-demographic variables, only the non-linear effect of age on POL > 2 carries over from the ordered probit models. The income effect on PAY > 2 is still negative but statistically insignificant.

4.2. Examining determinants and potential endogeneity of consequentiality perceptions

To identify determinants of WTP for the proposed initiative, a simple binary probit model of the dichotomous WTP response is presented as a baseline (left-hand side in Table 4). In line with expectations, the probability of a "Yes" response to the valuation question is affected negatively by the tax amount (TAX). Respondent income (INCOME) has a positive effect, whereas the fact that some respondents do not state their household income (NO_INC) has a negative effect on the probability of voting in favour of the proposed initiative. The effect of age (AGE and AGE2) is non-linear indicating that the likelihood of a "Yes" response decreases with age for younger respondents and increases for older ones. The negative effect of MALE suggests that male respondents have a lower probability of voting in favour of the proposed initiative. Results further show positive and significant coefficients of the binary indicators of payment (PAY > 2) and policy consequentiality (POL > 2), respectively, implying that the probability of a "Yes" response to the valuation question is higher for those respondents who view the survey as either way consequential. Mean WTP evaluated at the respective mean of all explanatory variables in the binary probit model is NOK 5,673 with a 95% confidence interval of [4,865-6,952].

To examine the issues of the effect of the tax amount on consequentiality beliefs and potential endogeneity of these variables in the voting equation, an instrumental variable approach based on a multivariate probit model is adopted. To identify this model, an analyst needs to select one or more instrumental variables which explain consequentiality perceptions but do not correlate with the error term of the main equation, i.e. the dichotomous WTP response. Yet the instrument(s) may affect the WTP variable indirectly because of potential endogeneity of perceived consequentiality. Two variables which likely fulfil these requirements for the binary indicators for payment (PAY > 2) and policy consequentiality (POL > 2) are two binary variables indicating (strong) agreement with the statements: "My decisions and behaviour can help reduce marine plastic litter" and "My personal actions do NOT play a significant role in

the health of the marine environment". The first variable is denoted as DECISIONS, and the second one as ACTIONS. Both variables capture a general sense of the respondent's perceived ability to influence the environmental problem in question. Therefore they should affect a respondent's belief regarding the consequentiality of their survey responses. At the same time, we do not expect a direct effect of either variable on the dichotomous choice WTP response. Both statements, which were assessed before the valuation section in the questionnaire, are very general and refer to any type of behaviour or decisions. They do not make reference to any government-led initiatives or any financial contribution to such measures. Therefore, it is not obvious whether a person that feels their actions and decision might somehow affect marine plastics pollution will have a lower or higher probability of supporting the propose measures. We use two instrumental variables in the model as it is not clear a priori which of them would better explain which consequentiality belief indicator, or whether the explain both indicators simultaneously. We therefore let the multivariate probit model decide on the relevance condition, without making any arbitrary assumptions.

For payment consequentiality (PAY > 2), the coefficient of the instrumental variable ACTIONS is significant and negative in the first stage of the trivariate probit model (Table 4). While the effect of the variable DECISIONS is not significant based on traditional significance levels ($p = 0.180$), it is positive as expected and so adds to explaining the variation in payment consequentiality perceptions. The tax amount (TAX) has a significant and negative effect on the payment consequentiality belief. This first important result indicates that higher tax amounts lead to weaker perceived payment consequentiality.

In the policy consequentiality equation (POL > 2), the coefficient of the instrumental variable DECISIONS is significant and positive. Note that the coefficient of the instrumental variable ACTIONS is near zero and insignificant, so this instrument does not add much variation in that equation. As the second important result of this model, the effect of the tax amount (TAX) in this equation is significant and positive, indicating that the higher the tax amount a respondent is presented with the more they perceive their response to impact the decision on whether to implement the initiative. Examining the socio-demographic variables, only the coefficients of respondent's age (AGE and AGE2) are significant, with the likelihood of perceiving the survey as policy consequential declining for younger respondents and increasing for older participants.

Table 4: Binary probit, and trivariate probit models with instrumental variables

	Binary probit		Trivariate probit	
	Coef.	**Std. Err.**	**Coef.**	**Std. Err.**
Equation 3 – Voting equation: DV = WTP response				
TAX	-0.168***	(0.026)	-0.143***	(0.033)
MALE	-0.220*	(0.120)	-0.133	(0.117)
AGE	-5.148**	(2.299)	-2.716	(2.283)
AGE2	5.205**	(2.321)	2.639	(2.318)
CHILD	0.051	(0.145)	0.078	(0.141)
UNIVERSITY	0.183	(0.124)	0.113	(0.118)
BEEN	0.261	(0.179)	0.199	(0.167)
INCOME[a]	0.305*	(0.180)	0.378**	(0.166)
NO_INC	-0.324**	(0.139)	-0.281**	(0.134)
PAY > 2	0.718***	(0.165)	1.364**	(0.640)
POL > 2	0.240*	(0.136)	1.222***	(0.450)
CONSTANT	1.045**	(0.524)	-0.962	(0.754)
Equation 1 – Payment consequentiality equation: DV = PAY > 2				
TAX			-0.094***	(0.029)
MALE			-0.128	(0.139)
AGE			-2.825	(2.636)
AGE2			2.544	(2.662)
CHILD			0.110	(0.163)
UNIVERSITY			0.065	(0.146)
BEEN			0.069	(0.207)
INCOME[a]			-0.179	(0.188)
NO_INC			0.202	(0.173)
DECISIONS (IV)			0.243	(0.182)
ACTIONS (IV)			-0.622***	(0.228)
CONSTANT			1.957***	(0.590)
Equation 2 – Policy consequentiality equation: DV = POL > 2				
TAX			0.056**	(0.026)
MALE			-0.061	(0.121)
AGE			-4.248*	(2.318)
AGE2			4.785**	(2.342)
CHILD			-0.239	(0.145)
UNIVERSITY			0.137	(0.127)
BEEN			0.001	(0.175)
INCOME[a]			-0.245	(0.168)
NO_INC			-0.014	(0.144)
DECISIONS (IV)			0.388***	(0.148)
ACTIONS (IV)			0.036	(0.234)
CONSTANT			1.247**	(0.509)
$\rho_{vote,pay}$			-0.558*	(0.325)
$\rho_{vote,pol}$			-0.664**	(0.236)
$\rho_{pol,pay}$			0.324***	(0.088)
Log-likelihood	-311		-824	
Number of parameters	12		39	
BIC	698		1,895	
Number of Halton draws	-		1,000	

Notes: N=552. DV – dependent variable. ***, ** and * indicate the 1%-, 5%- and 10%-level of significance, respectively. INCOME is in NOK 1,000. The sample mean of NOK 790.95 was imputed for the 132 respondents who did not state their income.

Hence, looking at both consequentiality equations in comparison, higher tax amounts lead respondents to perceive the survey as more policy consequential but less payment consequential. This implies that respondents faced with higher tax amounts find it more likely that their responses can influence the decision whether to implement the proposed initiative, but find it less likely that these large tax amounts will indeed be imposed. This result constitutes an interesting extension to the work of Groothuis et al. (2017), who assess consequentiality in general (without separating payment and policy consequentiality) and observe that with higher tax amounts, perceived consequentiality becomes weaker. In the light of our findings, this might suggest, for example, that respondents answering the Groothuis et al. (2017) survey interpreted the consequentiality statements more in terms of payment consequentiality. These and other possible mechanisms for these results are discussed in the subsequent section.

In the voting equation of the trivariate probit model, a number of variables affect the probability of a "Yes" response to the proposed initiative. The coefficient of the tax amount (TAX) is significant and negative; respondent's income (INCOME) affects the probability positively; and the fact that respondents do not reveal their income (NO_INC) has a negative effect on the probability. These findings are in line with the binary probit model discussed before. In addition to that, the negative effect of MALE and the non-linear effect of respondent age are still there but not statistically significant. Importantly, the coefficients of both instrumented consequentiality variables (PAY > 2 and POL > 2) are positive and significant. Perceptions of payment and policy consequentiality make it more likely that a respondent votes in favour of the initiative.

The last important result of the trivariate probit model concerns the correlation between the error terms of the different equations, reported in the lower part of Table 4. This correlation is significant and negative (at the 10%- and 5%-level, respectively) between the payment consequentiality equation and the voting equation ($\rho_{vote,pay}$) and the policy consequentiality equation and the voting equation ($\rho_{vote,pol}$). These results suggest that the binary indicators of payment and policy consequentiality are endogenous in the main voting equation. This means that payment or policy consequentiality, respectively, and the voting response are correlated to one or more unobserved factors (e.g. a respondent characteristic which the model does not controlled for). The negative signs of $\rho_{vote,pay}$ and $\rho_{vote,pol}$ indicate that these unobservable characteristics lower the likelihood of a "Yes" response to the WTP question while increasing the chance that the respondent perceived the survey as (payment/policy) consequential.

We find these correlations of the error terms while simultaneously controlling for the potential correlation of the error terms between the payment and policy consequentiality equations ($\rho_{pay,pol}$). This correlation is significant and positive, which reflects the positive correlation between the indicator variables of the two measures highlighted above.

5. Discussion and conclusions

Prompted by the contribution of Carson and Groves (2007), in the past ten years there has been substantial empirical research into the role of consequentiality perceptions in stated preference surveys for value elicitation. This study adds to this research by looking at the influence of perceived payment and policy consequentiality on responses to a single dichotomous choice WTP question. The application is a valuation survey on the benefits of reducing marine plastic pollution in the Norwegian Arctic. The analysis adopts an instrumental variable approach based on a trivariate probit model to assess the influence of perceived consequentiality of the survey on the dichotomous choice WTP response and the effect of the proposed tax amount on these perceptions. In accordance with the majority of previous studies (e.g. Forbes et al. 2015, Groothuis et al. 2017, Hwang et al. 2014, Interis and Petrolia 2014), the analysis finds that respondents who perceive the survey as consequential have a higher likelihood of voting in favour of the proposed initiative, which involves environmental improvements and coercive cost for undertaking the considered measures. This result is confirmed for both payment and policy consequentiality perceptions, which is in partial contrast to Zawojska et al. (2019) who report a negative effect of payment consequentiality on WTP for renewable energy development in Poland based on a discrete choice experiment involving a sequence of multiple choice questions.

The main result of our analysis is the confirmation of an earlier finding (Groothuis et al. 2017) that consequentiality perceptions might be a function of aspects of the experimental design, such as the proposed tax amount. While Groothuis et al. (2017) observe that it is less likely for respondents to perceive the survey as consequential with increases of the tax amount displayed in the valuation question, our study suggests that this outcome holds only for payment consequentiality, that is, for the likelihood as perceived by respondents that the tax amount will indeed be collected when initiative is implemented.

At the same time, our study provides some evidence that the effect of the tax amount is positive for policy consequentiality, that is, for the probability as seen by respondents that the survey

results will be taken into account by policy makers when deciding whether to carry out the initiative or not. This result might arise because respondents perceive the proposed tax amount as a 'lever' to affect the implementation decision. The higher the tax amount a respondent sees in the survey, the more weight they might think their referendum response is going to carry when it comes to the implementation decision. Another possible explanation is the fact that, with the current strong public focus on marine plastic pollution (Stafford and Jones 2019), large parts of the Norwegian population know that implementing measures to curb this type of pollution in the Arctic are extremely costly. Hence, if asked to contribute only a relatively small amount towards this issue, respondents might not find it credible that the measures can be effective and the initiative will be implemented. The existing dataset of this survey does not allow for further analysis of these speculative mechanisms but future research could look into this question.

The finding that socio-demographic variables are hardly correlated with consequentiality perceptions confirms earlier results (Needham and Hanley 2019, Vossler and Watson 2013). The lack of empirical associations between respondents' socio-demographic characteristics and self-reported consequentiality perceptions makes the validation of questions to assess the latter even more problematic. This adds to the existing concern around the use of Likert-type attitudinal questions for the empirical assessment of consequentiality perceptions (Lloyd-Smith et al. 2019, Needham and Hanley 2019).

Our results around endogeneity of the consequentiality perceptions are in line with that of Groothuis et al. (2017) in that there is negative correlation between the error terms of the payment and policy consequentiality and WTP response equations. We note, however, that this finding is sensitive to the cut-off defining the binary consequentiality variables. A potential weakness of this finding is the choice of instrumental variable in the trivariate probit model. It has been notoriously difficult in the literature to identify an instrument of consequentiality perceptions which is both strong and valid. An empirical test of the validity of instruments is often not possible. Hence we argue that agreement to two attitudinal statements capturing the respondents' perceived ability to influence the environmental problem *in general* only affects the voting decision through the channel of consequentiality but not in a direct way. Acknowledging this debate around valid instruments for consequentiality perceptions, however, we suggest caution in the interpretation of the findings around the correlation of error terms in the trivariate probit model and the endogeneity of consequentiality beliefs. However, the clear effects of the tax amount of these beliefs are independent of the choice of instrument.

In fact, trivariate probit models with endogenous binary variables are theoretically identified even without an instrument as long as there is sufficient variation in the vectors of exogenous regressors in all equations (Wilde 2000). This is confirmed when replicating the trivariate probit model results in Table 4 without the instruments (not reported here) – the negative (positive) effect of the tax amount on payment (policy) consequentiality perceptions can still be detected, and the estimated coefficients are significant.

Another feature of the survey to note is that the respective tax amount which a respondent was shown was repeated in the wording of the payment consequentiality statement but not in the one to measure policy consequentiality. If solely this repetition of the tax amount in the statement for payment consequentiality were driving the results, one would have expected an effect of the tax amount only on the perceptions of payment consequentiality. The fact that the link between the tax amount and perceived policy consequentiality is also significant, however, makes this conclusion rather unlikely. The tax amount clearly affects responses to consequentiality questions no matter if the specific amount is repeated or not. This also suggests that, even though the present study uses somewhat different wordings of perceived consequentiality questions than Groothuis et al. (2017), the tax amount is still found to influence consequentiality.

The findings in this study add to the chequered evidence around the determinants and validity of consequentiality perception questions in stated preference surveys. The fact that our study does not detect a negative effect of the tax amount on policy consequentiality goes slightly contrary to the results in Groothuis et al. (2017) in that respect. However, our results partly confirm the findings in Lloyd-Smith et al. (2019) who do not find this effect at all. The latter study also finds that the positioning of the consequentiality questions, before or after the valuation question, affects responses. So while socio-demographic variables do not typically affect consequentiality perceptions, there is growing evidence that the experimental design and valuation scenario do have an effect. While for the latter this is desirable, effects of components of the experimental design, such as the vector of tax amounts, are problematic since these have to be randomly allocated across respondents and can therefore differ from realistic cost estimates for the proposed environmental project (Flores and Strong 2007). The lack of concert among results from tests of endogeneity issues concerning self-reported consequentiality of the survey and valuation responses may be due to the fact that consequentiality could be context dependent. Asking for a relatively low tax contribution when the good under consideration will demand comparably large investment to be implemented may render the survey unrealistic.

This may be the reason why in the present survey the randomly allocated tax amount increases perceptions of policy consequentiality. For other environmental goods, such as water conservation (Groothuis et al 2017) or advice to boil tap water (Lloyd-Smith et al. 2019), there is either less media attention around such projects or the public are less informed about costs. In such situations, even small contributions to the project may seem realistic to cover implementation costs. In conclusion, the findings of the present analysis highlights the challenges of validly capturing and modelling indicators of consequentiality perceptions in stated preference studies. Therefore, and in light of the existing empirical literature on consequentiality, the results of the present study call this approach further into question. There is as of yet no validation of commonly used consequentiality questions.

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