Assessing Hypothetical Bias in Nudging: Willingness to Pay for Consultation towards Improved Forest Management

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Abstract

Stated preference studies have begun to adopt nudges to influence behavior, frequently as informational treatments. One potential issue is hypothetical bias, the observed effect of the nudge may be different in the hypothetical elicitation compared to a real elicitation. We test if the effect of information nudge/treatment such as social norm and financial incentives varies between hypothetical and real elicitation in the context of landowners' willingness to pay (WTP) for receiving private forest consultation. We used the payment card elicitation format and employed BDM auction for generating real transactions. We observe conventional hypothetical bias (HB), with overstated WTP in the hypothetical elicitation. We find the effect of the hypothetical social norm marginally significantly lower than the control. Further, the certainty correction eliminated HB not just in basic HB, it also fixes it in HB of information nudge/treatments.

Key words: hypothetical bias; informational nudge; willingness to pay; private forest consultation

1. Introduction

Stated Preference (SP) studies often test the effect of information treatments. Tests of information treatments in SP studies have existed for several decades, such as Blomquist and Whitehead (1998) who found that information on the natural resource's quality significantly affected willingness to pay (WTP). The information treatment has been applied to influence hypothetical WTP in diverse fields including food (Aoki et al. 2010; Roosen et al. 2011), animal conservation (Samples et al. 1986), and best management practice adoption (Zhong et al. 2018). However, the effect of information treatment may be subject to HB in SP. Aoki et al. (2010) find evidence that the effect of information treatment varies between a real lab experiment and a hypothetical field survey.

Researchers have applied the principles from behavioral economics and psychology to nudge people toward a desired outcome (Sunstein 2016). SP studies have also begun to adopt information treatment nudges. These are distinct from the previous information treatments (Samples et al. 1986; Zhong et al. 2018). In the past several years, different studies use information treatment as a nudge in conjunction with SP and have expanded to several sectors such as energy, recycling, insurance, forest management, and art. Informational nudges are the type of information provision designed to encourage alternative behavior by influencing individuals' preferences and choices without prohibiting any available options or significantly changing economic incentives (Thaler and Sunstein 2008).

Several meta-analyses (Nemati and Penn 2020; Buckley 2020) demonstrate the success of information and nudges to affect behavior in water and electricity usage. Some examples of information nudge on SP include providing energy information labels to nudge household energy efficiency decisions (Newell and Siikamäki 2014); using social norm information to influence household recycling levels (Czajkowski et al. 2019); using information about forage loss and potential indemnity payment to increase enrollment in agricultural insurance (Davidson and Goodrich 2021); use of positive framing and wording for influencing acceptability of wood ash application in the forest (Ouvrard et al. 2020) as well

as nudging art lovers to donate to nonprofit art organizations using loss aversion and gain frames (Lee et al. 2017).

Despite the widespread use of and demonstrated effect of nudges in SP studies, one potential issue is potential hypothetical bias (HB) in the nudge outcomes. Much like the HB of conventional information treatments (Aoki 2010), this means the effect of a nudge on WTP in a stated elicitation is overstated compared to its effect in a real elicitation. HB is a prime concern in the stated preference method, the difference between hypothetical versus real responses (Murphy et al. 2005; Penn and Hu 2018). Recently, Davidson and Goodrich (2020) examined information nudge for farmers' insurance enrollment decisions. They find that the nudge in a "consequential" choice, in which the farmer can share their insurance enrollment answers from the survey with a crop insurance agent is not significant. The same nudge in a hypothetical choice was significant, indicative of an upward bias in the information nudge's measured effect. Moreover, the evidence that the information treatment effect varies between a real lab experiment and a hypothetical field survey (Aoki et al. 2010) provides enough space to suspect that the effect of informational nudges may vary between hypothetical and real elicitation resulting in HB in the effect of nudge. However, the difference between the effect of nudge outcomes between hypothetical and real elicitation has not been explored enough, lacking comparison with real WTP studies. To our knowledge, we are the first to examine the difference between nudge outcomes between hypothetical and real WTP implementing both hypothetical and real WTP elicitation settings. More broadly, we are also a test of whether information treatments, more generally, are also subject to hypothetical bias.

We examine the presence of HB for a “Social Norm” as information nudge and a “Financial Incentives” as information treatment. These represent two different, but common information nudge and information treatment implemented in the literature. This experiment is in the context of understanding family forest landowners’ maximum WTP to receive a consultation with a private forest consultant towards sustainable forest management. The use of social norm information is one of the most commonly

used nudges for influencing people's behaviors for several purposes including resource conservation (e.g., electricity use (Allcott 2011), water use (Ferraro et al. 2011)), food choices (Gonçalves et al. 2021), conservation practice continuation after payment cease (Kuhfuss et al. 2016), and pro-environmental behavior such as recycling (Czajkowski et al. 2019). The growing literature on nudges using Social Norm demonstrates that providing information about peoples' own behavior relative to others can influence their behavior. We use Social Norm to influence the landowners' WTP for forest consultation, an important step toward forest certification. We provided the information to landowners about the forest certification status of the county in which their forestland is located as well as the certification status of three leading counties in terms of certification in their state. This information indicates that the forest certification in their county is very low compared to those leading counties in their state. Financial incentives can be used as an information treatment such as using crop insurance subsidies (conditional on conservation compliance) for influencing voluntary conservation efforts (Czap et al. 2015). In our study, we inform the landowners about the three financial incentives of working with private industry foresters for nudging them toward consultation.

Several studies exist showing the importance of forest health and its associated ecosystem services. An important step toward sustainable forest management is to obtain a forest management plan, which is an approved written management plan to support landowner objectives, which can include profitability as well as improving forest health. Such plans help align public and private interests in forest health. In addition, several voluntary forest certification programs such as the American Tree Farm System (ATFS), Forest Stewardship Council (FSC), and Sustainable Forestry Initiative (SFI) that support the adoption of conservation practices among NIPF landowners for improving forest health also require a forest management plan. While about 11 million private forest landowners manage about 56 percent (about 423 million acres) of the US forest land, family forest owners account for 92 percent of the private forest owners and 62 percent of the private forest land (35 percent of the US forest land) (Butler 2008).

However, the adoption of a forest management plan is low resulting in low participation in healthy forest management programs such as forest certification (Leahy et al. 2008; Lowe et al. 2011).

One reason is landowners' unfamiliarity and lack of knowledge to support adoption, often for the first requirement, a forest management plan (Kilgore et al. 2007), so solutions to lowering this barrier are essential to promote healthy forest management. One solution is to use the expertise of forest consultants, who can generate forest management plans for a fee. A forest consultant can guide landowners through the process of obtaining and implementing a forest management plan customized to forestland's conditions, landowner's goals with the land, and management activities that align with these objectives, including certification of a forest. A challenge though is to what extent family forest landowners are willing to pay for forest consultants' services, which cost hundreds.

For the remainder of this article, Section 2 contains the research hypothesis; Section 3 includes a review of relevant literature; Section 4 describes the experimental design, survey implementation procedure, and econometric methods employed; and Section 5 presents the results, followed by concluding thoughts and discussion in Section 6.

2. Literature Review

2.1 Use of Informational Nudges in SP

Nudging is related to choice architecture that alters the context of people's behavior (Thaler and Sunstein 2008). According to dual-process theory, the human brain functions based on two distinct thinking approaches, automatic (System 1) and reflective thinking (System 2) (Hansen and Jespersen 2013; Jung and Mellers 2016; Kahneman 2011). System 1 is associated with automatic cognitive processing and is characterized as fast and instinctive. In contrast, System 2 is associated with more deliberate and conscious processing of information. Nudge can also be classified similarly. System 1 nudges are more automatic, relying on defaults and status quo such

as automatic enrollment into saving programs, smaller servings of meals, etc. System 2 nudges provide information to decision-makers for more thoughtful decisions such as warning signs, calorie labels, providing nutrition charts, etc. The use of nudges has rapidly grown due to its relatively low cost and prospects of achieving public policy goals (Sunstein 2014). There is increased popularity of nudge in several sectors including government, business, academia, etc. (Sunstein and Reisch 2017).

The use of nudges for influencing WTP in SP studies has grown over time. Besides informational nudges, some other types of nudges have been used in SP such as default (Penn and Hu 2021). The review of SP studies in Table 1 shows that informational nudges are effective for changing peoples' behavior in SP studies. However, not all nudges have a significant effect. Moreover, for the same behavior change, one nudge is better than the other, and several factors of nudge such as level of nudge, and proximity matter. In this context, there is enough space to expect that if these informational nudges may have a different effect when we implement them for real policy implications.

Despite the growth in the use of nudges for influencing WTP in SP studies, one potential issue overlooked is if the nudge effect in previous SP studies remains in a real elicitation. In other words, to what extent is the effect of nudge reduced once controlling for HB? If the effect of a nudge in hypothetical elicitation is different compared to the real elicitation, that case we may not realize the full benefit of such nudges when we practically implement such nudges for some policy purposes. For example, Social Norm nudge has promising results in different SP studies. So, if we decide to use Social Norm information for increasing farmers' participation in the conservation program, then the effect of nudge may be different than what we got in the hypothetical context of SP studies. This prevents us from achieving the conservation enrollment

target as well as wastage of resources for nudge implementation such as the collection of social norm information may be costlier. To our knowledge, this is the first study to explore the actual HB in nudge implementing both hypothetical and real WTP elicitation.

3. Methods

3.1 Experimental Design

Hypothesis 1: The null hypothesis is that the effect of the nudge/information treatment on WTP is equal in the hypothetical and real elicitation.

1a. There is no difference in the effect of Social Norm on WTP for receiving private forest consultation between hypothetical and real elicitation.

1b. There is no difference in the effect of Financial Incentives on WTP for receiving private forest consultation between hypothetical and real elicitation.

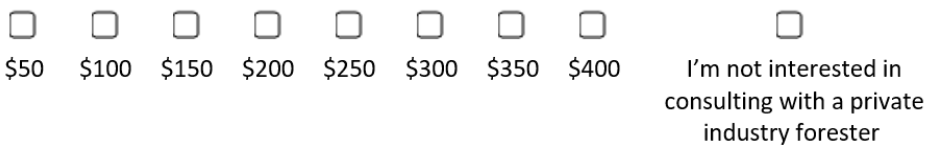
We conducted our experiment in the context of understanding family forest landowners' maximum WTP to receive a consultation with private industry forester towards obtaining a forest management plan. We use two survey distribution modes, online and mail, which is important to the experimental design. In the online survey, we implemented both hypothetical and real WTP elicitation treatment employing a within-subject experimental design; each person first participates in the hypothetical elicitation followed later in the survey by the real elicitation. Because of the within-subject design, the survey was completed online to avoid contamination between hypothetical and real elicitation by restricting respondents from going back to earlier questions in the survey. Only respondents who expressed interest to receive consultation in the hypothetical elicitation saw the real elicitation.

We initially invited landowners to participate in the survey online-only to provide a chance to watch the video and enhance attention to the information treatment. However, in addition to an online survey, we provide a mail survey option given that landowners in our sample are from relatively old age and rural backgrounds. This provides landowners more flexibility of choosing a feasible survey mode which may increase their survey participation. The mail survey was a between-subject design meaning a single respondent either get a hypothetical or a real elicitation question but not both. This is because the mail surveys lack the mechanism to restrict respondents from going back to earlier questions in the survey which may result in contamination between hypothetical and real elicitation values. To maintain the consistency of the mail survey design with the online survey, we closely followed the format and presentation of the online survey. We used a payment card (PC) approach to elicit landowners' WTP to receive private forest consultation in a hypothetical as well as real setting, with listed values from $50 to $400 in $50 increments. Payment levels offered to landowners were based on the discussion with forest experts and further validated in focus groups with different stakeholders including consultants, landowners, forest experts, and representatives from Louisiana and Arkansas forestry associations.

The hypothetical elicitation section starts with a description of the scenario. In this scenario, landowners were presented with two alternatives, WTP for a private forester or a free consultation with a public forester. The landowners would choose whether or not to accept the consultation with each type of forester. While the focus of our study is on WTP for a private forester, the free public forester may be a substitute and may have had an effect. We ensure that landowners have full information before they make hypothetical choices, mitigating any potential order effects. Before presenting a hypothetical scenario, the landowners were presented

with a comparison table explaining the main differences between the private and the public forester. The landowners were then asked two different hypothetical questions, each for a private and public consultation, first offering the "private forester" option. We maintained consistency between private and public elicitation formats. The private forester value was elicited as a one-time willingness to pay for having a consultation for a year. In the "public forester question" landowners' were asked whether or not they are interested in receiving a public consultation as well, regardless of their response in the "private forester question". The information on landowners' interest in receiving a public consultation, while useful, is beyond the scope of this study, so this is ignored in this analysis. The hypothetical elicitation question for private forester was worded in the following way for both online and mail surveys:

> *A **private industry forester** can guide you through the process of obtaining and implementing a forest management plan customized to your forestland's conditions, your goals with the land, and management activities that align with these objectives, including ATFS certification for your property.*
>
> *What is the **maximum** amount you would be willing to pay to receive an **initial consultation** with a **private industry forester** to work towards obtaining a forest management plan and, if desired, ATFS certification?*
>
> *(This one-time fee is for a consultation and does not guarantee a management plan nor ATFS certification.)*



We followed hypothetical elicitation with a certainty follow-up question to calibrate WTP estimates based on the level of certainty indicated by the respondents for their stated WTP

values (Blomquist et al. 2009; Penn and Hu 2020). The degree of certainty for expressed WTP value is measured in a quantitative certainty scale ranging from 0 to 10, where 0 means the lowest certainty, and 10 corresponds to the highest certainty.

The real treatment utilized a Becker-DeGroot-Marschak (BDM) auction mechanism, an incentive-compatible elicitation i.e., subjects have an incentive to reveal their bids truthfully (Lusk 2003; Lusk and Shogren 2007). The format and the presentation of the hypothetical and real elicitations were the same except for the BDM auction mechanism in the real elicitation, described more below. In the online survey, questions about landowner's outreach preferences appeared between hypo and real elicitations which help landowners to distinguish between hypothetical and real elicitation settings. The outreach questions are about the forest management information received by landowners in the past and their preference for receiving information in the future. This elicitation for both the hypothetical and real purchase of a private good with a much higher value than typically seen in related studies allows us to test the extent of HB in a high-stakes payment scenario.

Prior to the real elicitation, landowners were informed that they will have a real opportunity to have a consultation if a negotiated price with the consultant is less than their WTP, but they will only pay the negotiated price. However, there will be no consultation opportunity if a negotiated price with the consultant is higher than their WTP. The negotiation will occur between the researchers and the consultants in the future, so the landowners did not know the price a priori, eliminating the chance of strategic behavior. Further, we assured the respondent that we will not check or reveal their selected amount before we negotiate with the private industry forester.

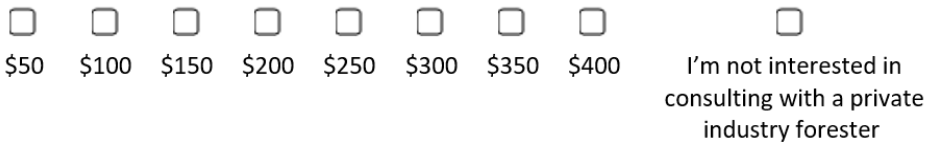
In the online survey, before presenting a real elicitation question, we presented a video[1] to respondents explaining the BDM auction mechanism, containing an example of a winning and losing (i.e., not able to pay to obtain the consultation) outcome. Respondents unable to watch the video instead read through the transcription of the instructions. The transcription of video instruction was presented as follows:

> *We are in the process of identifying a **private industry forester** to negotiate a set price so that interested forest landowners like you have a real opportunity to have a consultation.*
>
> *The questions are similar to before, but this time your answers are **REAL**. If the negotiated price is lower than the maximum amount you say you are willing to pay for a consultation, we will connect you with the private industry forester in order to schedule a consultation, but you will only pay the negotiated price. If the maximum amount you are willing to pay for a consultation is less than the negotiated price, then we will not connect you with the forester. At this point, the price a private industry forester may charge is unknown. We will NOT check or reveal your selected amount prior to our negotiation with the private industry forester.*
>
> *Please read and **click** the statement below to show that you understand and agree to the following terms:*
>
> *I understand that this is a real opportunity to pay for a consultation with a private industry forester. If a private industry forester is willing to visit my property for a negotiated price lower than what I select, my contact information will be shared so that a consultation can occur.*

[1] Viewable at the following link.

We presented similar information including examples in the mail survey for explaining the BDM auction mechanism. The real elicitation question was worded as follows for both online and mail surveys:

> *A **private industry forester** can guide you through the process of obtaining and implementing a forest management plan customized to your forestland's conditions, your goals with the land, and management activities that align with these objectives, including ATFS certification for your property.*
>
> *What is the **maximum** amount you would be willing to pay to receive an **initial consultation** with a **private industry forester** to work towards obtaining a forest management plan and, if desired, ATFS certification?*
>
> *Remember, this is a **real purchase scenario** as described in the previous video.*
>
> *(This one-time fee is for a consultation and does not guarantee a management plan nor ATFS certification.)*



To examine whether the nudge outcomes are different between hypothetical and real elicitation, we used two types of informational nudge treatments. We used between sample design meaning we randomly assigned each participant to one of two informational nudge treatments or to control. We displayed assigned informational nudge on the preceding page of each hypothetical WTP elicitation, real WTP elicitation, and both in case of within-design, just

before the treated participant made the decision for obtaining private forest consultation. We have three experimental treatments:

Social Norm: Landowners received information about certification status (number of certified farms and certified acres of forestland) specific to their county, three leading counties in their state for certified tree farms mentioning the county with the most number of certified farms, and the county with the most certified acres of forestland. Since landowners received information specific to their county, we have 8 versions of social norm treatment (four per state).

Financial Incentives: Landowners are told about three financial incentives of working with a private industry forester as higher returns, for-profit status, and easy access to forestry service providers.

Control: Landowners received no informational nudge. The display of social norm and financial incentives treatments provided to landowners are shown in Panels 1.1 and 1.2 of Figure 1, respectively.

3.2 Survey Design

The experiment was embedded within a survey containing several sections: (1) property characteristics and landowners' general ownership patterns (e.g., property size, proximity to residence, ownership objectives, etc.), (2) management characteristics (e.g., past and future management plans), (3) participation and perception on private and government certification programs, (4) landowners' perception on certification, (5) Information on ATFS certification, forest management plan, and forest consultation, (6) outreach information, (7) hypothetical and real WTP elicitation question, and (8) landowners' demographic information. We tested our

survey instrument in several focus groups including landowners, forest consultants, and representatives from the Louisiana Forestry Association and Arkansas Forestry Association. Each focus group participant also completed a draft of our survey instrument before the discussion. We further modified survey instruments based on their feedback. The final survey was approved by the Louisiana forestry association, Arkansas Forestry Association, and Institutional Review Board of Louisiana State University.

Our survey includes family forest landowners in four Louisiana counties (Morehouse, Ouachita, Union, and Winn) and four Arkansas counties (Ashley, Bradley, Cleveland, and Drew). In total, we had a sample frame of 4324 landowners that we contacted for our online survey, comprising 3343 landowners from Louisiana and 981 landowners from Arkansas. The first wave was strictly online, but the second wave was a combination of online and mail surveys. In the second wave, we sent a follow-up mail survey to 4106 landowners (3187 and 919 landowners in Louisiana and Arkansas, respectively) who didn't participate in the online survey in the first wave. However, the online survey was also available in the second wave if they wanted to complete the survey online. Survey participation occurred through the mail using the Tailored Designed Method following Dillman et al. (2014) in March-June 2021. Potential respondents were randomized to receive an incentive of $5 and $10 Amazon gift card or donation to a charity to complete the survey, examined in a separate study.

3.3 Theoretical Framework and Econometric Model

For the real treatment, we combined PC elicitation with the BDM auction. In a BDM auction, the person submits a bid and gets a chance to purchase a good only if the price is greater than a randomly picked market price, but only pays the amount equal to the randomly picked market

price while making the actual purchase (Lusk and Shogren 2007). BDM auction mechanism is incentive compatible; subjects have an incentive to reveal their bids truthfully (Lusk 2003; Lusk and Shogren 2007). We chose the BDM format because it allows for individual bidding without requiring a group of subjects (Lusk 2003). This enables investigation of individual landowners' WTP for receiving private forest consultation in a real, incentive-compatible elicitation.

Following Lusk and Shogren (2007), let landowner *i* places the value V_i on private forest consultation. The landowner submits a bid (i.e. chose WTP amount in payment card for receiving private forest consultation), b_i, to obtain a consultation. If the landowner wins the auction by submitting the bid higher than the market price which is the future negotiated price between the researcher and private forest consultant for providing consultation service, he or she derives utility from the difference between his or her value for consultation and the market price of consultation, as given by $U_i(V_i - p)$, where p is the market price of consultation and *U* is a utility function increasing in income. If the landowner does not win the auction by submitting a bid lower than the market price of consultation, his or her monetary value from bidding is normalized to zero. At the time the bid is submitted, the landowner does not know the negotiated market price of consultation and thus does not know the price that will be paid. In effect, the price is a random variable.

Suppose landowner *i*'s expectation about the price is characterized by the cumulative distribution function $G_i(p)$ with support $[\underline{p}_i, \overline{p}_i]$ and the associated probability density function $g_i(p)$. The goal of the landowner is to submit a bid, b_i, to maximize expected utility, which is given by equation 1:

$$E[U_i] = \int_{\underline{p}_i}^{b_i} U_i\,(V_i - p) dG_i(p) + \int_{b_i}^{\bar{p}_i} U_i \quad (1)$$

$$= \int_{\underline{p}_i}^{b_i} U_i\,(V_i - p) g_i(p) dp + \int_{b_i}^{\bar{p}_i} U_i\,(0) \qquad (2)$$

The first integral is taken over all price levels less than the landowner's bid: cases in which the landowner wins the auction. The second integral is taken over all price levels greater than the landowner's bid: cases in which the landowner loses the auction.

Normalizing $U(0) = 0$, we find the optimal bid by taking the derivative of expression (2) with respect to b_i and setting the derivative equal to zero which results in:

$$\frac{\partial E[U_i]}{\partial b_i} = U_i(V_i - b_i) g_i(b_i) = 0 \qquad (3)$$

Equation 3 is solved when $b_i = V_i$. The landowner's utility is maximized when the landowner submits the bid (WTP amount in PC) equal to his or her value for the good i.e. private forest consultation.

If a landowner reports a WTP higher than his value for consultation, the negotiated price for consultation may exceed his value, which would cause him to lose money; if he reports a WTP less than his value for consultation, he may lose an opportunity for consultation offered at a reasonable price. So, either over or under-reporting of value for consultation runs the risk of either paying too much or missing out on a good deal, which drives the landowner toward simply reporting his true value for receiving a consultation. BDM mechanism separates what a person pays from what they say, which induces incentive compatibility.

To examine the WTP for private forest consultation, we used the random utility model to analyze the data from our payment card elicitation following Haab and McConnell (2002). Assuming landowner *i* has the following indirect utility derived from their forestland, expressed in equation 4:

$$u_{ij} = u_{ij}(y_i, \boldsymbol{z}_i, \varepsilon_{ij}) \qquad (4)$$

Where j=1 is a final state (hereafter "consultation"), if landowners select to receive private forest consultation; j=0, if landowners decide not to receive private forest consultation and prefer to remain at the status quo. The utility is a function of y_i, the landowner's discretionary income, $\boldsymbol{z}_i$ vector of the landowner's demographic characteristics and attributes of forest-related choices, and ε_{ij} as the component of preferences known by individual landowners but is not observable to the researcher. Following the random utility theory, the true utility a landowner derives from the forest is a combination of both deterministic, $v_{ij}(y_i, \boldsymbol{z}_i)$ and stochastic, ε_{ij} components, and is presented in equation 5.

$$u_{ij}(y_i, \boldsymbol{z}_i, \varepsilon_{ij}) = v_{ij}(y_i, \boldsymbol{z}_i) + \varepsilon_{ij} \qquad (5)$$

The utility-maximizing landowner will be willing to pay *WTP* amount for receiving consultation as long as the utility obtained from the forest quality after consultation with the deduction of the payment amount, *WTP* exceeds the status quo utility of the forest, shown in equation 6.

$$u_1 = u(y_i - WTP_i, \boldsymbol{z}_i, \varepsilon_{i1}) \geq u_0 = u(y_i, \boldsymbol{z}_i, \varepsilon_{i0}) \qquad (6)$$

Following Boyle (2017) and Haab and McConnell (2002), we will use interval regression to analyze our payment card data. Consider that there are K payments, $t_1, \ldots, t_k$ presented in ascending order so that $t_k > t_{k-1}$. If a landowner chooses the payment amount t_k, then the probability that the landowner selects this payment is the probability that *WTP* lies between t_k and t_{k+1}, as expressed in equation 7.

$$\Pr(choose\ t_k) = \Pr(t_k \leq WTP < t_{k+1}) \qquad (7)$$

Responses to the payment card can be treated in a parametric model by specifying $WTP = \mu + \varepsilon$. We can estimate the effect of covariates by replacing μ with $\boldsymbol{z}_i\beta$. Where individual landowner *i* selects the payment t_k, which is a form of an interval model in which every landowner picks some payment. We assume a normal distribution for *WTP*, such that $WTP = \boldsymbol{z}_i\beta + \varepsilon_i$, where $\boldsymbol{z}$ is a vector of covariates, β is a vector of parameters, and ε is the error term. If ε is normally distributed with mean zero and variance σ^2, then

$$\Pr(choosing\ t_k) = \Phi\left(\frac{t_{k+1}-\boldsymbol{z}_i\beta}{\sigma}\right) - \Phi\left(\frac{t_k-\boldsymbol{z}_i\beta}{\sigma}\right) \quad (8)$$

Where $\Phi\left(\frac{t_{k+1}-\mu}{\sigma}\right)$ is the standard normal CDF evaluated at $\left(\frac{t_{k+1}-\mu}{\sigma}\right)$. The maximum likelihood function is given by equation 9.

$$lnL = \sum_{i=1}^{N}(\Phi\left(\frac{t_{k+1}(i)-\boldsymbol{z}_i\beta}{\sigma}\right) - \Phi\left(\frac{t_k(i)-\boldsymbol{z}_i\beta}{\sigma}\right)) \quad (9)$$

Mean *WTP* is derived from the expression in equation 10.

$$WTP = \alpha + \sum(\bar{\boldsymbol{z}}\beta) \quad (10)$$

α represents a constant term in interval regression.

The regression models use the interval amount based on their corresponding selection in the payment card as the dependent variable. We adjusted the reported hypothetical WTP based on certainty follow-up score provided by landowners, following hypothetical elicitation. We appropriately converted the certainty scale of 1-10 to a probability scale with a range of 0.1-1 and multiplied landowner's stated WTP by their certainty score expressed as a probability (e.g., for least certain response with certainty follow-up score 1, WTP is multiplied by 0.1 and for most

certain response with certainty follow-up score 10, WTP is multiplied by 1) (Adhikari et al. 2017; Brandolini and Disegna 2012).

The interval regression contains grouped into eight groups of variables. *Hypo* represents whether the WTP elicitation is hypothetical or real and is expected to be positive due to the presence of HB (Murphy et al. 2005; Penn and Hu 2018). We include two informational nudge treatments *Social Norm* and *Incentives*. All else equal, we expect nudges to be positive because social norm demonstrates that providing information about peoples' own behavior relative to others can influence their behavior. We expect that when landowners get information that their certification rate is low compared to other counties in their state, it increases their WTP for consultation as an important step towards forest certification. In financial incentives, we inform landowners about several financial benefits of working with private forest consultants. Tian et al. (2018) report a positive association between price premium due to certification and landowners' interest in certification. So, we expect that the information on the financial benefit of certification increases landowners' interest in certification increasing their WTP for consultation. Moreover, we hypothesize that the effect of nudge is higher in hypothetical than in real elicitation. Therefore, we include the interaction of nudge with *Hypo* to examine our hypothesis that the effect of nudge varies between hypothetical and real elicitation. We expect these interactions *Hypo*Social Norm* and *Hypo*Incentives* to have a positive sign. Because we expect that the effect of nudge is much higher in hypothetical elicitation than in real with a higher increase in hypothetical WTP.

The demographics consist of state to see if landowners' WTP for consultation varies between two states. Other demographics consist of male, age, education, income, and retirement status. Some studies (Kline et al. 2000; Knoot et al. 2015; Van Herzele and Van Gossum 2009)

revealed that female landowners are more concerned about the environment, so we expect *Male* landowners to have a negative association with WTP for consultation. Chhetri et al. (2018) find a negative association of age with the probability of hiring consultants, but a positive association of higher education with the willingness to hire consultants. Tian et al. (2018) also show that education is positively related to interest for certification. So, we anticipate a negative sign for *Age60* and a positive sign for *Education.* We expect *Retired* to have a negative sign since they can allocate more time for forest management by themselves. We controlled for survey mode as *Online* (as opposed to mail survey).

Property characteristics include *Forest Size100, Tenure, and Proximity*. Landowners with larger forest areas have a higher likelihood of hiring a consultant and participating in forest certification (Chhetri et al. 2018; Creamer et al. 2012; Ma et al. 2012). So, a positive sign is expected for *Forest Size100*. Landowners who own their forestland for a longer period are more likely to participate in forest certification (Bensel 2001; Tian et al. 2018). We anticipate a positive sign for Tenure. Another property characteristic is the *Proximity* of the landowner's residence to forestland. Conway et al. (2003) find that proximity is an important factor in land management decisions with an absentee (i.e., landowner lives 50 or more miles away from the property) generally less likely to engage in timber harvesting action. We expect *Proximity* to be negative since absentee landowners are less active in forest management activities. The importance of ownership variables includes *Inheritance, Wildlife, Timber, Privacy,* and *Hunting*. We expect a negative sign for *Inheritence* and *Privacy* but a positive sign for *Wildlife*, *Timber,* and *Hunting*. Tian et al. (2018) report that landowners with timber production as an ownership objective are more interested in certification.

We included several management characteristics on WTP such as whether landowners adopted one or more *Conservation Practices* in the past five years such as forest wetland protection, streamside management, revegetation/replanting, timber harvesting, prescribed fire, forest pest suppression, forest management plan, and met with the consultant. We anticipate that the adoption of any *Conservation Practice* to have a positive association with WTP for consultation. According to Creamer et al. (2012) having a management plan or stewardship plan increases the likelihood of certification participation. However, other studies (Chhetri et al. 2018; Tian et al. 2018) report that a management plan does not affect the likelihood of hiring consultants and participation in certification. We expect *Management Plan* to have a positive relationship with WTP since acquiring a management plan is an important prerequisite for certification. *Met Consultant* is expected to be positive because receiving professional advice increases landowners' likelihood of getting their forestland certified (Creamer et al. 2012). we also account for landowners' previous certification status for different certification programs such as FSC, SFI, or ATFS represented by *Certification* and enrollment in any cost-share program represented by *Cost-Share*. We expect positive signs for both *Certification* and *Cost-Share.* Moreover, we included the effect of a review of informational materials provided to landowners containing ATFs certification information represented as a *Brochure*. Studies (Butler 2008; Kilgore et al. 2007; Leahy et al. 2008) report that the unfamiliarity of family forest landowners about certification resulting low participation in certification. So, we expect a positive association between the extent of review of informational materials and WTP for consultation. Because landowner who has more knowledge and familiarity with certification including benefits, requirements, and procedures of certification is more likely to receive a consultation.

4. Results

4.1 Variables and Descriptive Statistics

In total, we received 578 responses from landowners, 462 from Louisiana, and 116 from Arkansas yielding a response rate of 14.1%, 14.6% in Louisiana, and 12.6% in Arkansas. Following Butler et al. (2021), we excluded 151 responses who either were not forest landowners, did not report number of acres owned, failed to respond to 25% of the questions, or did not answer the WTP elicitation. Therefore, we use 427 responses in the analysis below, based on those who exclusively answered a hypothetical or real elicitation (mail respondents) or those who answer both hypothetical and real elicitation (online respondents).

Out of 427 responses, we received 202 and 225 responses via online and mail surveys, respectively. In the online survey, landowners who participated in hypothetical WTP elicitation, a high percentage (129 of 202, 63.9%) are uninterested in a private consultation. This low adoption rate matches previous studies (Leahy et al. 2008; Lowe et al. 2011). We did not subject these uninterested respondents to real elicitation. Empirically if people say no in the hypothetical elicitation, they are typically very certain and extremely unlikely to switch to a different, costly option in the real elicitation (Loomis and Ekstrand 1998; Ready et al. 2010). Therefore, we assume their real WTP for consultation as zero and considered as within design response during our analysis. The remaining 73 landowners who participated in the online survey had a positive WTP for receiving private forest consultation in the hypothetical elicitation. Only 58 of these 73 landowners report their real WTP for receiving private forest consultation, with the remaining 15

failing to answer the real elicitation, and excluded from further analysis.[2] In total, we have 187 (129+58) within-design respondents, each with a hypothetical and real WTP response.

We received 225 mail responses, of which 133 and 92 participated in hypothetical and real elicitations, respectively. As in the online sample, a high percentage of landowners are uninterested (e.g. WTP=0) in consultation, whether in the hypothetical (80.5% of 133,) or real elicitations (81.5% of 92). Combining both online and mail surveys, we included 412 responses generating 706 observations: 320 hypothetical (online: 187; mail: 133) and 386 real (online: 187; mail: 199) observations.

With respect to the nudge treatments, the mail response rate for Social Norm, Financial Incentives, and Control is 6.8% (70), 8.1% (71), and 9.2% (84), respectively. Within each treatment, about half (53%) of all responses received were hypothetical elicitation in the three treatments, with the remainder providing real elicitation responses. This demonstrates successful randomization to either the hypothetical or real elicitation.

Summary statistics and corresponding variable definitions appear in Table 2. The landowners are predominantly male (75%) and more than 60 years old (87%). About 61% of landowners have earned bachelor's degrees or advanced degrees and more than half (51%) of the landowners are retired. The average landowner holds 136 acres of forestland for about 21.66 years. In terms of ownership objectives, about 53.1% of landowners mention that passing down land to the next generation is an extremely important reason for owning forestland with an average ranking value of 4.19, followed by supporting wildlife (37.1%), maintaining privacy (34.9%), timber production (31.5%), and hunting (30.5%), respectively. In the past five years,

[2] Possible reasons for failing to respond to the real elicitation include confusion, strategic response, or protest.

about half (49%) of the respondents implement one or more conservation practices. Only 8% of landowners have forest management plans and only 17% of landowners met with forest consultants in the last five years. Only 5% of landowners have enrolled in forest certification programs and 21% enrolled in cost-share programs.

Table 3 displays the distribution of nudge treatments and control by demographic characteristics such as gender, age, education, and forest characteristics such as forest size holdings. The sample is balanced regarding demographics and forest holdings. The t-test shows that the landowners in different treatment groups are not significantly different for any of these characteristics except for a slightly significant difference between some groups for education status.

Table 4 shows the distribution of certainty unadjusted hypothetical and real WTP in PC by treatment. The distribution of WTP under each elicitation scenario suggests no clear pattern of whether the different treatment groups generate different valuations. We conduct a Kolmogorov–Smirnov test to determine whether the hypothetical and real WTP distributions are statistically equivalent within each treatment. The Kolmogorov–Smirnov test fails to reject the equality of distribution between hypothetical and real WTP within each treatment as shown by the p-value in Table 4.

To gauge the representativeness of our survey sample, we benchmark it with the Louisiana and Arkansas outcomes of the National Woodland Owner Survey (NWOS) for family forest ownership (Butler et al. 2021) (Table A1). This comparison is for several demographic and forest ownership characteristics. Several differences between our sample and the NWOS outcomes. Significantly more males and those under age 65 in Louisiana, whereas the Arkansas sample owns significantly more acres than the NWOS. The sample from both states is

significantly more educated. The variation between our survey outcome and NWOS is that our survey was very obviously focused/advertised on forest certification so we wouldn't expect it to match NWOS, which was not focused on sustainable forest management. A better comparison would be of our survey sample compared to other recent surveys advertising sustainable forest practices.

4.2 Regression Results

The results of interval regression models for calculating landowners' WTP for receiving private forest consultation appear in Table 5. Table 5 presents the certainty unadjusted interval regression results i.e., without adjusting WTP for hypothetical bias. Model 1 only includes an indicator for hypothetical elicitation responses. It shows that *Hypo* is positively significant indicating the presence of HB in WTP for consultation. Model 2 only includes indicator variables for the information nudge/treatment to test the effect of informational nudge/treatment on landowners' WTP for receiving private forest consultation.

Model 3 incorporates *Hypo, Social Norm, Incentives,* and the interaction of *Hypo*Social Norm* and *Hypo*Incentives* to see if the effect of information nudge/treatment on WTP varies between hypothetical and real elicitation. Consistent with Model 1, *Hypo* is significant indicating HB. Consistent with Model 2, neither *Social Norm* nor *Incentives* are significant indicating that compared to the control, the use of either social norm or incentive information does not have a significant effect on WTP for receiving private forest consultation. The success of information/nudge treatments in meta-analyses of water and electricity consumption (Buckley (2020) Nemati and Penn (2020))'s are measured as intensive margin, meaning these nudge studies are for changing the behavior of currently used. In our study, the effectiveness is

measured as an extensive margin. Landowners are not deciding how many acres to receive consultation for (which would be the intensive margin), but rather deciding whether to receive a consultation at all (which is the extensive margin). This may be one potential reason why our result is different than these studies. Neither *Hypo*Social Norm* nor *Hypo*Incentives* is significant showing no significant difference in the effect of information nudge/treatment between hypothetical and real elicitation.

Model 4 is the expansion of Model 3 incorporating respondents' demographics, survey mode regarding whether a landowner completes a survey online or by mail as well as property characteristics, forest ownership reasons, management characteristics, and review of forest certification informational materials known to be important in previous studies. When we control for explanatory variables in model 4, the results are still consistent with Model 3 for *Hypo, Social Norm,* and *Incentives*. However, *Hypo*Social Norm* is negatively significant indicating that the effect of hypothetical social norm is marginally significantly lower than the control, which is opposite of what we expected that hypothetical nudge would lead to higher WTP than control inducing HB. *Hypo*Incentives* is not significant indicating that, there is no significant difference in the effect of incentive on hypothetical and real WTP for receiving a consultation.

Louisiana is insignificant showing that there is no significant difference in WTP for receiving private forest consultation among the landowners of Louisiana and Arkansas. The *Male* is insignificant, showing that gender does not have a significant effect on WTP for private forest consultation. *Age* is insignificant showing that compared to the landowner with age below sixty years, the respondent with age more than sixty years has no difference in WTP for receiving private forest consultation. *Education* is not significant, indicating no effect of education on WTP for private forest consultation. Consistent with our study, gender does not

affect the landowners' probability of hiring a consultant and participating in certification (Chhetri et al. 2018; Tian et al. 2018). However, in contrast to our result, they find higher age significantly decreases the probability of hiring consultants and participating in forest certification, whereas higher education increases the likelihood of hiring consultants and certification participation. *Retired* is insignificant suggesting that the retirement status of the landowner does not affect WTP for receiving forest consultation. *Online* is not significant indicating no difference in WTP between landowners' who completed the survey online from those who completed a mail survey.

Regarding property characteristics, *Forest Size100* is not significant meaning that the forest size does not have any effect on WTP for receiving private forest consultations. Consistent with Tian et al. (2018) but in contrast to Chhetri et al. (2018) and Ma et al. (2012), which show the positive effect of forest areas on willingness to hire the consultant and participation in forest certification. *Tenure* is not significant indicating that the forestland ownership duration does not have a significant effect on WTP for private forest consultation. Inconsistent with Tian et al. (2018) and (Bensel 2001)'s finding a positive association between the duration of forestland holding and certification. *Distance* is not significant showing no effect of residence proximity with forestland on WTP for consultation. Of the five ownership reasons included in the model; none of the ownership reasons is significant except *Privacy*. *Privacy* is negatively significant indicating that owning forestland for privacy purposes decreases WTP for consultation. Inconsistent with Gutierrez-Castillo et al. (2022), who find that the inheritance is a single ownership reason to significantly affect willingness for forest management activities such as forest thinning.

We also included several variables to examine the effect of management characteristics on WTP such as whether landowners adopted any conservation practice in the past, adoption of a management plan, meeting with the consultant, enrollment in the certification program, and cost-share program. However, none of the management characteristics have a significant effect on WTP for receiving private forest consultation. Consistent with Chhetri et al. (2018) who find that management characteristics such as having a written forest management plan do not affect the willingness to hire consultants. However, evidence exists that having a management plan or stewardship plan and receiving professional advice increases landowners' likelihood of getting their forestland certified (Creamer et al. 2012). Further, we included a *Brochure* to see the effect of certification informational materials provided to the landowners on WTP, but the effect is insignificant indicating no effect of review materials on WTP for consultation.

Table 6 shows the certainty adjusted interval regression results. Models 5, 6, 7, and 8 in Table 6 correspond to Models 1, 2, 3, and 4 in Table 5, respectively. The Table 6 shows that *Hypo* is not significant in all certainty adjusted models, which shows that the certainty correction eliminated HB. In Model 8, *Hypo*Social Norm* is not significant anymore after certainty correction. This shows that the certainty correction eliminates HB not just in basic HB, it also fixes it in HB of information nudge/treatments. The rest of the results in Table 6 are consistent with their corresponding Models in Table 5. In Table A3, we present the interval regression results considering another way of WTP adjustment i.e., we consider WTP equal to zero if the certainty score is equal to or less than seven. The result is consistent with the corresponding model in Table 6, except that the *Hypo* is negative, however, the effect is not significant. Table A4 shows the results obtained from variable reduction regression for Models 4, 8, and 12.

4.3 Mean Willingness to Pay

We compute the unadjusted and adjusted mean hypothetical WTP and mean real WTP for each treatment for receiving private forest consultation using the coefficients obtained in Model 4 and Model 8, respectively. For unadjusted WTP, for both social norm and incentives, the hypothetical WTP is less than in control, however, the real WTP is higher than control. However, in the adjusted WTP case, for both social norm and incentives, hypothetical as well as real WTP is higher than the corresponding WTP in the control group. Further, the increase in WTP due to information nudge/treatment is higher for real than hypothetical elicitation. Compared to control, the hypothetical and real WTP is higher by 4.6% and 27.3%, respectively for Social Norm. Similarly, the hypothetical and real WTP is higher by 5.6% and 13.6 % than the control group.

Table 7 also presents the Calibration Factor (CF) for each treatment, which is the ratio of mean hypothetical WTP and mean real WTP corresponding to each treatment. To examine the presence of HB in each treatment, we tested if CF is significantly different from one. However, we find that the CF is not statistically different from zero for all treatments in both unadjusted and adjusted WTP scenarios indicating the absence of HB. Moreover, Table 7 shows higher CF in the control group compared to the social norm and incentives for both unadjusted and adjusted WTP results. However, the certainty factors are not significantly different from each other as shown by the p-value in Table 7.

5. Conclusion and Discussion

We examine if the effect of information nudge/treatment on WTP for receiving private forest consultation varies between hypothetical and real elicitation scenarios using Social Norm as

information nudge and Incentives as information treatment. We used PC elicitation format and employed BDM auction for generating real transactions and used interval regression for data analysis. We observe conventional hypothetical bias (HB), with overstated WTP in the hypothetical elicitation. The certainty correction eliminates HB not just in basic HB, it also fixes it in HB of information nudge/treatments. To our knowledge, we are the first to examine if the effect of nudges varies between hypothetical and real elicitation, so we did not find any study to directly compare our findings with. Our results do not align with Davidson and Goodrich (2021), in that the effect of informational nudge can vary with consequentiality. We did not find any evidence of HB in treatment as well as control group.

Self-selection may be one of the limitations of our study since landowners voluntarily decide on whether to participate or not participate in the survey. Similarly, in the online survey, we do not have any information on why some respondents decide not to participate in real elicitation after participating in hypothetical elicitation. Moreover, although the online and mail survey is very close to each other in terms of format and presentation some technological limitations exist such as the lack of videos that explain the auction mechanism in the mail survey. We cannot apply a forced response to a particular question in a mail survey, so some respondents skip important information which increases missing data in mail responses. Our results contribute to HB and nudge literature. Additionally, the results are expected to provide a better understanding of family forest landowners' willingness to obtain a private forest consultation and participation in healthy forest management activities such as forest certification.

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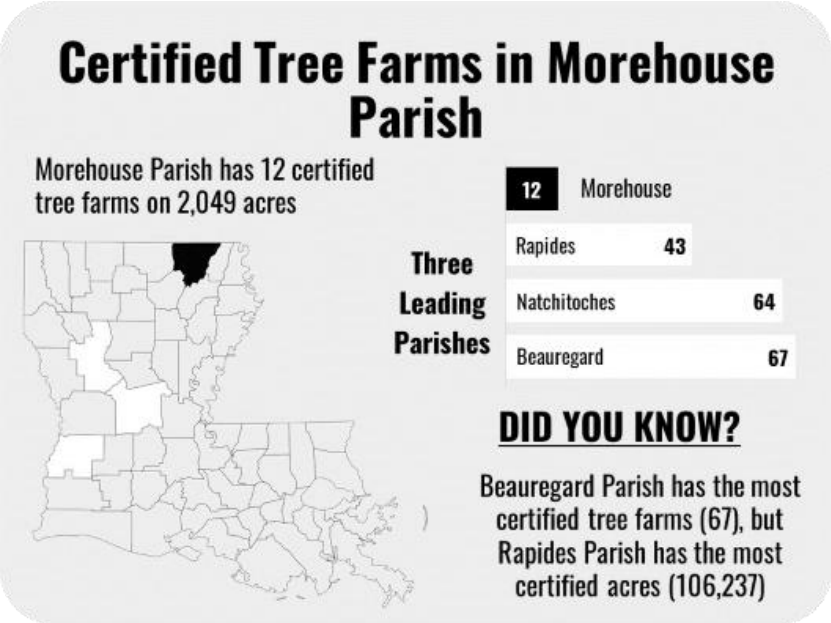
Figures

Figure 1: Display of Informational Nudge Treatments



Panel 1.1: Social Norm for Morehouse Parish of Louisiana

Panel 1.2: Financial Incentives

Tables

Table 1: List of SP Studies with Informational Treatment as Nudge

Study and Behavior	Informational Nudge Used	Outcomes
(Bradt 2019) • Influence homeowners purchase of flood insurance against low-probability, high consequence events	• Presenting flood risk in probability term (probability of inundation over a 30-years period)	• The informational nudge results in an increase in WTP for flood insurance of roughly $11/month.
(Coent et al. 2018) • Social Norm influence on agri-environmental schemes (AES) adoption	• Descriptive Norms (beliefs of other farmers) and Injunctive Norms (what farmers believe others/farmers)	• The injunctive norms (others) is significant but descriptive norms and injunctive norms (farmers) is insignificant.
(Czajkowski et al. 2019) • WTP for higher recycling level at household	• Social Norms varied as: absolute level, geographic proximity, and whether relative performance information is included	• Social norm information has a positive effect on WTP, but the effect is not necessarily monotonic, i.e., highest social norm levels not necessarily being the most effective; the highest level of social norm shows less effect than the moderate level of social norm. • The lower level of social norm shows no significant difference in WTP with change in proximity. However, high levels of Social Norm when used together with a city rather than a country as a reference, the resulting WTP is lower. • The nudge effect is stronger when more information on relative performance is provided. • The people's response to Social Norm depends on the current engagement level with household recycling; a respondent who is sorting at a higher level responds

		negatively towards Social Norm but respondents with a lower level of sorting respond positively.
• (Davidson and Goodrich 2021) • Farmer enrollment in pasture, rangeland, and forage rainfall index insurance	• Wide Framing insurance decision as a risk management tool (reminding participants of the three months that are most important for rainfall to occur to avoid forage loss • Narrow Framing insurance decision as a one-time investment (informing participant of the three months when a producer in that area is most likely to receive an indemnity payment)	• Framing insurance as a risk management decision increases the probability of insurance enrollment, whereas framing insurance as a one-time investment has little to no effect on enrollment. • Further, they examine nudges outcomes in consequential settings, by providing farmers with the option to receive a copy of their insurance enrollment decisions to share with a crop insurance agent after the study. • The finding suggests that in consequentiality setting, the treatment effects are smaller and not significant, indicating the presence of HB in the effect of nudge.
(Kuhfuss et al. 2016) • Farmers' enrollment of land into agri-environmental schemes	• Conditional collective bonus (If aggregate farmers' participation reached a given threshold, additional monetary bonus is paid)	• The collective bonus increases the likelihood of farmers' participation in agri-environmental schemes. Further, conditional bonuses encourage farmers to enroll larger area of their land.
(Lee et al. 2017) • Art gallery donations	• Loss-Framed: used loss Aversion (losing existing art exhibitions due to funding scarcity) • Gain-Framed (additional art exhibition due to more funding)	• Significant effect of loss aversion on willingness to donate among frequent gallery-goers whereas both frames are effective among non-frequent gallery-goers, but the gain frame has a much stronger effect.

(Newell and Siikamäki 2014) • Nudging for energy efficiency decisions	Energy efficiency labels • Energy Guide Label (economic information: estimated yearly operating cost, physical information: estimated yearly energy use, and cost range of similar model, color scheme) • Energy Efficiency Grade Label (set of colored bars labeled supplemented by lettered ranking of efficiency) • Energy Star Logo (display approved for high-efficiency product model) • Label with Co2 emission by appliances	• The lack of sufficient information significantly undervalues energy efficiency. • The monetary value of energy saving (estimated yearly estimating cost) is most important for cost-efficient energy efficiency investment. • Information on physical energy use guide has incremental value in decision. • Operating costs within the cost range of available models did not have significant additional value. • Co2 emission information generally had incremental value but is of lesser importance than economics and physical information · WTP for Co2 reduction of about $10-$20 per ton.
(Qi et al. 2022) • Use of informational nudges for enhancing consumers' WTP for ugly foods	Information Disclosure • Linking the purchase of ugly food to reductions in food waste • Providing information that ugly foods are natural and authentic	• Proper information improves consumers' WTP for ugly food. • Presenting dual messages simultaneously (i.e., linking between the purchase of ugly food and food waste reduction as well as emphasizing the authenticity and naturalness of ugly carrots) enhance consumers' WTP for ugly carrot significantly. However, when the information is presented individually, did not enhance the ugly carrot demand significantly.
(Ouvrard et al. 2020) • Nudging to increase the acceptability of wood ash application in forest	• Positive Framing: present as pro-environmental behavior • Information (wording): recycling wording (highlight recycling aspect of ash application); productive	• Positive framing and productive wording influence the willingness to pay but depend on the attitudes of the respondents.

	wording (emphasize the role of ash for higher wood production)	
(Filippini et al. 2020) • Nudging for the adoption of electric motorcycle	• Information on running/lifetime cost • Showing smiley icon for pollution • Priming (pollution)	• Positive effect.

Table 2: Descriptive Statistics (N=412)

Variable	Description	Mean	Std. Dev	Expected Sign
Elicitation				
Hypo	1 if hypothetical elicitation, else 0 (i.e., Real)	0.45	0.50	Positive
Nudge				
Social Norm	1 if Social Norm, else 0 (i.e., Control)	0.32	0.47	Positive
Incentives	1 if Financial Incentives, else 0 (i.e., Control)	0.32	0.47	Positive
Control	Else 0 (no use of nudge)	0.36	0.48	
Demographics				
Louisiana	1 if Louisiana, else 0 (i.e., Arkansas)	0.80	0.40	
Male	1 if landowner is male, else 0 (i.e., female)	0.75	0.44	Negative
Age60	1 if landowner is 60 years or older, else 0 (i.e., younger than 60 years)	0.87	0.34	Negative
Education	1 if landowner has attained at least a bachelor's degree, else 0 (i.e., Less than a bachelor's degree)	0.61	0.49	Positive
Retired	1 if landowner is retired, else 0 (i.e., not retired)	0.51	0.50	Negative
Survey Mode				
Online	1 if returned online, else 0 (i.e., mailed)	0.45	0.50	
Property Characteristics				
Forest Size100	Continuous: Size of the forest tracts or stands (Measured as per 100 acres)	1.36	5.39	Positive
Tenure	Length of forestland ownership (years)	21.66	14.96	Positive
Proximity	Residence proximity to forestland (1= live on or within a mile from forestland, 6=live more than 250 miles away)	3.14	1.98	Positive
Importance of Ownership (5: extremely important, 1: not important)				
Inheritance	A family heritage to pass on to heirs	4.16	1.17	Negative
Wildlife	Protect or improve wildlife habitat	3.98	1.08	Positive
Timber	Timber production	3.58	1.29	Positive
Privacy	Maintaining privacy	3.53	1.49	Negative
Hunting	Hunting purpose	3.47	1.41	Positive
Management Characteristics				
Conserv Practices	1 if any conservation practice adopted in the past 5 years, else 0 (i.e., no conservation practices adopted)	0.49	0.50	Positive
Management Plan	1 if the landowner has implemented a management plan, else 0 (i.e., no management plan implemented)	0.08	0.28	Positive
Met Consultant	1 if the landowner has previously met with a forest consultant, else 0 (i.e., never met with a consultant)	0.17	0.38	Positive
Certification	1 if landowner enrolled in certification under FSC, SFI or ATFS, else 0 (i.e., never enrolled in certification program)	0.05	0.22	Positive
Cost-Share	1 if the landowner is participant in any cost-share program, else 0 (i.e., never participated in cost-share)	0.21	0.41	Positive
Review of Informational Materials (5: all of it, 1: not at all)				
Brochure	Review of brochure	2.89	1.48	Positive

Table 3: Comparison of Demographics & Forest Size between Treatments (N=412)

	Total (n=412)	Social Norm (A) (n=133)	Incentives (B) (n=130)	Control (C) (n=149)	H_0: A = B p-value	H_0: A = C p-value	H_0: B = C p-value
Male	0.75	0.70	0.77	0.77	0.244	0.181	0.903
Age (years)					0.736	0.381	0.224
<45	0.06	0.06	0.06	0.05			
45-54	0.08	0.07	0.11	0.05			
55-64	0.23	0.24	0.20	0.24			
65-74	0.41	0.41	0.42	0.41			
75+	0.23	0.22	0.20	0.25			
Education					0.034	0.083	0.579
High School/ GED or less	0.16	0.12	0.22	0.14			
Some College/ Associate	0.24	0.20	0.20	0.30			
Bachelor's or more	0.60	0.68	0.58	0.56			
Forest Size (acres)					0.466	0.956	0.465
1-9	0.04	0.04	0.05	0.04			
10-19	0.11	0.14	0.08	0.12			
20-49	0.28	0.28	0.32	0.26			
50-99	0.25	0.25	0.22	0.26			
100-199	0.19	0.17	0.17	0.22			
200-499	0.10	0.10	0.12	0.08			
500-999	0.02	0.02	0.02	0.01			
1000-4999	0.01	0.02	0.01	0.00			
5000+	0.00	0.00	0.01	0.00			

Note: p-value calculated using t-test.

Table 4: Distribution of Hypothetical and Real WTP in PC by Treatment (n=706)

	Social Norm (n=233)		Incentives (n=222)		Control (n=251)	
WTP	**Hypo (n=105) (A1)**	**Real (n=128) (A2)**	**Hypo (n=101) (B1)**	**Real (n=121) (B2)**	**Hypo (n=114) (C1)**	**Real (n=137) (C2)**
$0	73.3%	82.0%	75.3%	87.6%	72.8%	87.6%
$50	4.8%	2.3%	4.0%	2.5%	7.0%	4.4%
$100	5.7%	4.7%	8.9%	0.8%	7.0%	2.2%
$150	3.8%	1.6%	1.0%	2.5%	0.9%	0.7%
$200	4.8%	3.1%	4.0%	0.8%	2.6%	2.2%
$250	3.8%	2.3%	3.0%	2.5%	2.6%	0.0%
$300	1.9%	2.3%	2.0%	1.7%	2.6%	1.5%
$350	1.0%	0.0%	0.0%	0.0%	1.8%	0.7%
$400	1.0%	1.6%	2.0%	1.7%	2.6%	0.7%
p-value	H_0: A1 = A2 0.732		H_0: B1 = B2 0.332		H_0: C1 = C2 0.117	

Note: Under each elicitation individual treatment sums to 100%. P-value calculated using Kolmogorov–Smirnov test.

Table 5: Interval Regression Results (n=583)

	Model 1		Model 2		Model 3		Model 4	
Variables	**Coefficient**	**Std. Err.**	**Coefficient**	**Std. Err.**	**Coefficient**	**Std. Err.**	**Coefficient**	**Std. Err.**
Constant	52.747****	4.409	58.161***	7.248	45.590***	6.366	56.735*	31.272
Hypo	18.935***	4.247			27.387***	7.782	26.938***	7.924
Social Norm			7.324	11.112	13.909	10.263	8.172	10.411
Incentives			2.453	10.787	8.016	10.589	3.456	10.261
Hypo*Social Norm					-14.110	9.523	-17.589*	9.661
Hypo*Incentives					-11.941	11.488	-13.911	11.133
Louisiana							-9.248	12.577
Male							11.418	11.563
Age60							-13.900	14.227
Education							6.137	9.333
Retired							-12.658	10.279
Online							12.852	8.448
Forest Size100							0.096	0.396
Tenure							-0.263	0.340
Distance							1.720	2.601
Inheritance							4.841	3.714
Wildlife							-1.956	5.643
Timber							-2.363	3.831
Privacy							-9.875**	4.809
Hunting							3.201	4.951
Conserv Practices							-4.152	9.041
Management Plan							15.998	23.441
Met Consultant							23.467	15.213
Certification							-7.258	19.183
Cost-share							4.548	11.408
Brochure							4.767	3.207

Table 6: Certainty Adjusted Interval Regression Results (n=583)

	Model 5		Model 6		Model 7		Model 8	
Variables	**Coefficient**	**Std. Err.**	**Coefficient**	**Std. Err.**	**Coefficient**	**Std. Err.**	**Coefficient**	**Std. Err.**
Constant	27.673***	4.388	22.440***	4.841	20.536***	6.340	32.627	26.700
Hypo	1.836	3.903			4.148	7.455	3.522	7.700
Social Norm			11.498	8.651	13.898	10.229	8.921	10.182
Incentives			7.205	8.720	7.964	10.537	4.443	10.047
Hypo*Social Norm					-5.249	9.169	-7.256	9.274
Hypo*Incentives					-1.624	10.357	-2.429	10.000
Louisiana							-5.181	10.482
Male							9.003	10.023
Age60							-17.046	12.449
Education							6.583	8.330
Retired							-5.669	7.930
Online							8.902	6.894
Forest Size100							0.086	0.342
Tenure							-0.317	0.244
Distance							0.242	2.138
Inheritance							3.252	3.193
Wildlife							0.225	4.666
Timber							-1.175	3.281
Privacy							-7.726	4.255*
Hunting							1.169	4.120
Conserv Practices							-3.879	7.408
Management Plan							11.712	18.465
Met Consultant							16.603	11.854
Certification							-4.086	15.974
Cost-share							5.176	9.672
Brochure							4.139	2.698

Note: Certainty adjustment calculated by multiplying the lower and upper interval of WTP by certainty response. For example, an initial payment card value of $50 and a certainty level of 8 has a certainty adjusted interval of 40 and 80.

Table 7: Treatment Wise Mean WTP and Calibration Factor (n=583)

	Unadjusted			Certainty Adjusted		
Treatments	**Hypothetical WTP ($)**	**Real WTP ($)**	**Calibration Factor**	**Hypothetical WTP ($)**	**Real WTP ($)**	**Calibration Factor**
Social Norm (A)	74.26	64.91	1.14	37.81	41.55	0.91
Incentives (B)	73.22	60.19	1.22	38.16	37.07	1.03
Control (C)	83.67	56.73	1.47	36.15	32.63	1.11
			p-value			
H_0: CF (A) = 1	0.157			0.520		
H_0: CF (B) = 1	0.269			0.877		
H_0: CF (C) = 1	0.108			0.677		
H_0: CF (C) = CF (A)	0.215			0.516		
H_0: CF (C) = CF (B)	0.283			0.795		
H_0: CF (A) = CF (B)	0.702			0.634		

Note: P-value calculated using the delta method.

Appendix

A1: Comparison of Study Sample versus NWOS

	Louisiana			Arkansas		
	This study (N=412)	**NWOS[1]**	**p-value**	**This study (N=412)**	**NWOS**	**p-value**
Gender						
Male	74.0[2]	65.0	0.001	77.5	78.0	0.914
Age (years)						
<45	5.4	<1.0		4.9	3.0	0.307
45-54	8.2	5.0	0.008	3.7	9.0	0.096
55-64	20.5	30.0	0.000	28.4	26.0	0.623
65-74	40.2	41.0	0.762	35.8	34.0	0.732
75+	21.2	24.0	0.224	23.5	28.0	0.363
Education						
High School/ GED or less	15.4	31.5	0.000	13.6	29.0	0.000
Bachelor's or more	25.4	20.5	0.050	12.3	28	0.002
High School/ GED or less	55.0	47.0	0.000	70.3	42.0	0.000
Forest Size (acres)						
1-9	4.5	<1.0		3.7	<1.0	
10-19	13.9	27.0	0.000	1.2	28.0	0.000
20-49	33.8	32.0	0.474	6.2	38.0	0.000
50-99	24.8	16.0	0.000	23.4	18.0	0.201
100-199	15.1	14.0	0.562	33.3	8.0	0.000
200-499	6.04	7.0	0.495	25.9	7	0.000
500-999	0.91	2	0.155	4.9	1	0.000
1000-4999	0.60	1	0.469	1.2	<1	
5000+	0.30	<1		0.0	<1	

[1]NWOS: National Woodland Owner Survey, 2018

[2]Data expressed as a percentage of total landowners in each state.

Note: P-value calculated using proportions t-test.

A2: Interval Regression Results (Recoded WTP=0 if Certainty Score≤7) (n=583)

	Model 9		Model 10		Model 11		Model 12	
Variables	**Coefficient**	**Std. Err.**	**Coefficient**	**Std. Err.**	**Coefficient**	**Std. Err.**	**Coefficient**	**Std. Err.**
Constant	52.772***	4.379	45.364***	4.780	45.612***	6.361	64.980**	26.943
Hypo	-2.346	4.235			-0.569	7.389	-0.098	7.351
Social Norm			10.689	8.141	13.917	10.265	9.224	10.299
Incentives			8.986	8.804	8.014	10.585	4.776	10.059
Hypo*Social Norm					-7.451	10.263	-9.508	10.019
Hypo*Incentives					2.210	10.745	1.094	10.019
Louisiana							-7.890	10.726
Male							6.401	10.267
Age60							-18.227	12.636
Education							7.122	8.822
Retired							-3.735	8.013
Online							7.447	7.008
Forest Size100							0.131	0.350
Tenure							-0.336	0.215
Distance							-0.556	2.127
Inheritance							3.104	3.238
Wildlife							0.907	4.797
Timber							-1.158	3.400
Privacy							-7.749*	4.416
Hunting							0.961	4.213
Conserv Practices							-3.013	7.465
Management Plan							7.821	18.407
Met Consultant							13.849	11.670
Certification							-4.738	16.290
Cost-share							1.435	9.445
Brochure							4.069	2.681

A3: Variable Reduction Models

	For Model 4		For Model 8		For Model 12	
Variables	**Coefficient**	**Std. Err.**	**Coefficient**	**Std. Err.**	**Coefficient**	**Std. Err.**
Constant	24.758	17.539	53.208***	16.995	49.885***	16.470
Hypo	16.869***	4.223			-10.467**	4.683
Social Norm						
Incentives						
Hypo*Social Norm						
Hypo*Incentives						
Louisiana						
Male						
Age60			-18.816	12.260	-20.548*	11.569
Education					9.249	6.863
Retired	-17.750**	8.419				
Online			9.026	6.639		
Forest Size100	11.998	7.826				
Tenure			-0.358	0.237	-0.288	0.177
Distance						
Inheritance	5.181	3.313				
Wildlife						
Timber						
Privacy	-9.888***	3.675	-6.886*	2.940	-5.195*	2.791
Hunting						
Conserv Practices						
Management Plan						
Met Consultant	25.119	15.813	20.137	12.269		
Certification						
Cost-share						
Brochure	4.778	3.235	4.673*	2.791	4.585*	2.580