ENCOURAGING PRO-ENVIRONMENTAL BEHAVIORS: POWER OF TESTIMONIALS

by

Rubait Rahman

A thesis submitted to the Faculty of the University of Delaware in partial fulfillment of the requirements for the degree of Master of Science in Agricultural and Resource Economics.

Summer 2019

ENCOURAGING PRO-ENVIRONMENTAL BEHAVIORS: POWER OF

TESTIMONIALS

by

Rubait Rahman

Approved: _____
Kent D. Messer, Ph.D.
Professor in charge of thesis on behalf of the Advisory Committee

Approved: _____
Thomas W. Ilvento, Ph.D.
Chair of the Department of Applied Economics and Statistics

Approved: _____
Mark Rieger, Ph.D.
Dean of the College of Agriculture and Natural Resources

Approved:

_____
Douglas J. Doren, Ph.D.
Interim Vice Provost for Graduate and Professional Education and Dean
of the Graduate College

TABLE OF CONTENTS

Chapter

Appendix

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Testimonials, such as videos or quotes from influencers who speak positively about a product or a practice, are a widespread, cost-effective, and tested marketing strategy for consumer goods. Given the appeal of testimonials in promoting pro-environmental behaviors, very little is known about whether testimonials can spur pro-environmental behaviors. To that end, an incentive compatible framed-field experiment was designed to test the impact of an expert testimonial on the willingness to pay for native plants as a pro-environmental technology. An ex-ante statistical power analysis was conducted to determine the required sample size. Our results indicate that the audio-visual testimonial did not have a statistically significant impact on the participants' willingness to pay for the pro-environmental technology. Several demographic and socioeconomic characteristics of the participants had a statistically significant impact on the willingness to pay for the pro-environmental technology. These findings are policy relevant as they suggest that testimonials are not a panacea, and they help identify a target population for environmental outreach programs.

Chapter 1

INTRODUCTION

Testimonials, such as videos or quotes from influencers who speak positively about a product or a practice, have been widely used to market consumer goods (see Martin et al., 2008; Shimp et. al., 2005; Bly 2005). It is reported as one of the most frequently used marketing strategies and referred as a "workhorse selling tool" that never goes out of vogue (Martin et al., 2008). Testimonials have also been shown as a cost-effective marketing strategy (Martin et al., 2008, Kemp et al 2015) that can promote demand for consumer goods (Wright and Lynch 1995, Shapiro and Spence 2002, Kemp et al 2015).

Despite being a widespread, cost-effective, and tested marketing strategy for consumer goods, less is known about whether testimonials can spur pro-environmental practices. To that end, this study was designed as a single-bounded, dichotomous choice, and incentive compatible framed field experiment to understand whether an audio-visual testimonial from an expert could promote pro-environmental behaviors. Specifically, we evaluate the effect of an audiovisual testimonial from an expert on participants' their willingness to pay for native plants as a pro-environmental practice. We chose native plants as the pro-environmental practice for our study because they are known to have many environmental benefits. For instance, native plants improve the biodiversity of an area by attracting a diverse variety of birds, insects, and animals (EPA, 2003). In addition, their maintenance requires less water, pesticides, and

fertilizer making them an environmental-friendly choice for landscaping (EPA 2002). Finally, like any other plants, they sequester carbon in conjunction with their unique benefits (EPA 2002). Thus, native plants were an ideal choice as a pro-environmental technology.

An ex-ante power analysis was conducted prior to conducting this study to determine the adequate sample size required to detect the treatment effect. The experiment was designed to detect a $1.5 change in the willingness to pay due to testimonials at a power of 0.95 with a sample size of 345. However, due to logistical challenges our study could recruit 309 participants only. Our ex-post power analysis shows that our collected sample size can detect the $1.5 change in the willingness to pay at a power of 0.87 with a sample size of 309.

The experiment randomly recruited 309 homeowners from the mid-Atlantic region to participate in the study. We conducted our study at community events and public locations that attract a diverse population. Our results indicate that several demographic and socio-economic characteristics of the participants such as age, income, lawn size, and prior engagement with pro-environmental best management practices (BMP) affected the purchasing decision of native plants, a pro-environmental practice. These findings make intuitive sense and are policy relevant as they indicate a target group for pro-environmental interventions.

We also find that the audio-visual testimonial did not have a statistically significant impact on participants' willingness to pay for native plants at the standard levels of significance. Although testimonials have been touted as an appealing low-cost strategy for conservation outreach programs, our study highlights a case in which a well-powered, revealed preference study found that testimonials had no effect on

conservation behavior. Given the appeal and the ease of implementation of testimonials in conservation outreach, this is an important addition to the literature. We find that although testimonials have been shown to be a cost-effective strategy in promoting demand for consumer goods in many cases (see Martin et al., 2008; Feick and Higie 1992; Kemp et. al., 2015), they may not be as effective at encouraging adoption of environmentally-beneficial practices.

Many environmental outreach programs that aim to promote pro-environmental behaviors by simply disseminating information have been ineffective in deriving the desired durable behavioral changes (Frederiks et. al, 2015). Our study adds to this growing body of literature by showing that providing information, even by means of expert testimonials through audiovisual modes may not be effective in encouraging pro-environmental behaviors. The findings will better guide the design of programs that promote the adoption of environmentally beneficial residential practices and technologies. Also, this study warrants testing of other behavioral nudges such as emotions, or social norms that have had considerable success in promoting pro-environmental behaviors (for review see Fredericks et. al., 2015). In fact, using such nudges within testimonials should be tested, given the ease and the cost-effectiveness of using testimonials in outreach programs.

The above findings, however, are contingent upon the validity of the power analysis. This study is sufficiently powered to detect a \$1.5 treatment effect on the participants' willingness to pay for a bundle of three native plants. However, this study is not well-powered to detect an effect size less than \$1.5. Further investigation is therefore required with a larger sample size, capable of detecting a smaller effect size in order to bolster the arguments from this study. This study therefore provides the

statistical power for this design for a range of effect and sample sizes to support future research in this area.

This thesis is organized as follows: chapter 2 provides an overview of pertinent studies in the literature, chapter 3 describes the research question and the experimental design, chapter 4 describes the methodology for the study, and chapter 5 reports the results of the experiment. Finally, chapter 6 provides concluding remarks.

Chapter 2

LITERATURE REVIEW

The efficacy of testimonials in promoting consumer goods has been widely studied in the marketing literature. (see Feick and Higie 1992; Friedman and Friedman 1979; Petty, Cacioppo, and Schumann 1983 Martin et al., 2008; Kemp et. al., 2015;). The usage of testimonials or endorsements in advertisements persuade consumers to trial a product and repeat usage, allowing them to gain more experience with the product and consequently, encouraging them to consider the product for their use, promoting demand for the product (Wright and Lynch 1995, Shapiro and Spence 2002, Kemp et al 2015). Testimonials provide a behavioral cue, such as aiding in remembering brand names, (Petty et. al. 1983; Biswas et. al. 2006), or enhancing message recall (Friedman and Friedman 1979, Biswas et. al. 2006). They also draw a more positive attitude toward the product (Raju et al., 2002) and make the advertisement more credible and effective (Friedman and Friedman 1979; Raju et. al. 2002, Kemp et al 2015). In addition, research shows that testimonials reduce performance risk (risk associated with the failure of a service or a product) (Kemp et al 2015) in conjunction with many other forms of risks faced by a consumer (Fredericks et. al., 2015). These are all results of an increased source credibility resulting from testimonials (Petty et. al. 1983, Singh et. al. 2004, Kemp et al 2015).

In this study we are particularly interested in whether expert testimonials can promote pro-environmental behaviors. It has been found that expert testimonials tend to make viewers more agreeable to the conveyed messages (Tedeschi 1972). Also, such testimonials mitigate several other forms of risks, associated with a product, faced by consumers and motivates them to trial the product (Biswas et. al. 2006).

There is experimental evidence in the marketing literature that demonstrates that customers identify themselves more closely with endorsers that presented them with audio/visual testimonials compared to text/picture testimonials and that such testimonials also generate a more positive rating for the product (Appiah 2006). As pointed out by Appiah (2006), these findings are in line with earlier research that shows that audiences show a more favorable attitude towards vivid multimedia communication modes compared to less vivid ones (Chaiken and Eagly 1983; Coyle and Thorson 2001; Li et al. 2002). Audio visual modes increase the salience of the communication and the social richness of the person endorsing the product (Chaiken and Eagly 1983). These features of the audio/visual communication derive a more positive attitude toward both the person endorsing the product as well as the product itself (Appiah 2006). These findings are also in line with earlier findings from the psychology literature that report that information provided through vivid means, such as pictures or videos, can promote pro-environmental behaviors (Jason et al., 1979; Ester and Winnet 1982; Winnet e al., 1982; Stern 1992). As a result, we decided to use an audio-visual testimonial for our study.

However, there is also evidence that suggests that consumers may be skeptical about testimonials when used in advertising. They may perceive that an endorser is endorsing a product simply because they are being paid (Chan, K. K. (1996). Entitled consumers may also feel that that they have missed one or more benefits of the product as described by a testimonial which may in turn may generate malicious envy and a negative review of the product (Martin et. al. 2019).

Much of the marketing literature about testimonials study the efficacy of testimonials in marketing consumer goods. Little is known about whether testimonials

can promote pro-environmental behaviors. Our study fills this void by studying the impact of an audio-visual expert testimonial on pro-environmental behaviors. In addition, the studies regarding testimonials in the marketing literature did not consider statistical power in their analysis. Our study bolsters its findings by adding statistical power in its analysis. So, the two main contributions of this study in the literature are- first, it studies the impact of an audiovisual testimonial on the willingness to pay for a pro-environmental practice. Finally, it considers statistical power analysis and provides a range of statistical power for different sample and effect sizes to bolster its findings as well as facilitating future research in this area.

Chapter 3

EXPERIMENTAL DESIGN

We conducted a single-bounded dichotomous choice framed-field experiment to understand whether an audiovisual testimonial from an expert, in conjunction with written information, be more effective over only written information in determining the adoption and the willingness to pay for native plants as a BMP. This study was designed with several steps and multiples research questions which are not addressed here as they are beyond the scope for this thesis[1]. The research question and the corresponding hypothesis along with its basic conclusion for this thesis is presented in table 1 below.

Table 1   Summary of Research Question, Hypothesis Test, and Result.

Research Question	Hypothesis Test	Results
Does consumers' WTP for native plants change when they receive a video testimonial in conjunction with written information relative to their WTP when	H_0 : $\text{WTP}^{\text{Testimonial}} = \text{WTP}^{\text{No Testimonial}}$ H_A : $\text{WTP}^{\text{Testimonial}} \neq \text{WTP}^{\text{NoTestimonial}}$	**Do not Reject**.

---

[1] This thesis is part of an economic experiment that was designed with three major steps to understand the impact of behavioral nudges on the willingness to pay, adoption, self-reporting, and persistent maintenance of pro-environmental technologies. In the first step, half of the participants were randomly selected to receive the native plant for free (and were part of the free treatment) and the other half of the participants were required to pay for the native plants (and were part of the pay treatment). Also, at this stage, half of the participants were randomly selected to view the audiovisual testimonial (and were part of the testimonial treatment) and the other half did not view the testimonial video (and were part of the no testimonial treatment). This thesis was conducted with responses from the participants from the pay treatment. In the second step, participants receiving the native plant were asked to send a picture message of the plant in the ground once in the summer of 2018 and again in the fall of 2018. At this stage, half of the participants received a financial incentive for each of the two times they sent the picture. In the final stage, selected participants were contacted for home visits to understand the health of the plant. Participants received financial incentives for allowing to visit their homes and taking a picture of the plant.

receiving only the written information?		

In this study, we are eliciting participants' preference for native plants as a pro-environmental practice in response to an audio-visual expert testimonial. Prior to conducting the study, we conducted an ex-ante power analysis to determine the adequate sample size required to detect the treatment effect. The experiment was designed to detect a $1.5 change in the willingness to pay due to testimonials at a power of 0.95 with a sample size of 345. However, due to logistical challenges, our study was only able to recruit 309 participants for this study. Our ex-post power analysis shows that our sample size can detect a $1.5 change in the willingness to pay at a power of 0.87. The statistical power of this design for a range of sample and effect sizes in dollars and standardized effect size is reported in table 2. Each of the rows correspond a particular sample size and each column corresponds an effect size with the standardized effect size in bracket. For instance, for a sample size of 400, our current design can detect an effect size of $1.25 or a standardized effect size of 0.25 at power of 0.82. This analysis is a key addition to the literature. This table will guide future research in determining their sample and effect size and understanding the corresponding statistical power of their study, should they conduct a similar study to understand the impact of testimonials.

Table 2   Statistical power of the design for a range of sample and effect sizes. The
           first column represents the sample sizes and the first row represents the
           effect sizes with the standardized effect sizes in bracket.

	Effect size in $\$$ (standardized effect size)						
Sample Size	0 (0)	0.25 (0.05)	0.50 (0.1)	0.75 (0.15)	1.00 (0.2)	1.25 (0.25)	1.50 (0.30)
309	0.05	0.08	0.18	0.25	0.37	0.70	0.87
350	0.06	0.09	0.18	0.29	0.40	0.75	0.91
400	0.06	0.09	0.21	0.32	0.48	0.82	0.93
450	0.07	0.11	0.25	0.34	0.51	0.85	0.95
500	0.07	0.12	0.29	0.40	0.54	0.87	0.97

By definition, adequate power means that the empirical method should be able to detect the effect size should it exist (Ioannidis, 2017). In conjunction with giving increased false negatives, underpowered studies are also likely to have increased errors in magnitude and their signs as well (Palm-Forster et al, 2019). As a result, considering the statistical power should be an important component of empirical methodologies.

Participation was entirely voluntary, and all participants were paid $10 for participating at the beginning of the study to ensure incentive-compatibility. Participants were recruited from various Mid-Atlantic regions: a large community event at the University of Delaware, the Christiana Mall located in Delaware and the creamery located at the University of Delaware. All three locations attracted a big and diverse population and hence were chosen as locations for this study. A snapshot of the data collection process is shown in appendix D. The entry restrictions for this study were: i) the participant must be 22 years old; ii) the participant must own a lawn.

After signing up for the study and receiving their participation fee, each participant was seated in a desk with a tablet computer. Participants were randomly

assigned to one of the between subject groups: i) treatment group and ii) control group (see table 3 for full summary of the treatment). Participants in the treatment group viewed written information about the benefits of native plants in conjunction with an audio-video testimonial from Dr. Doug Tallamy, who is a renowned ecologist, entomologist, and an acclaimed author. Dr. Tallamy is also a University of Delaware professor. In the video testimonial, Dr. Tallamy emphasized the importance of native plants in maintaining the biodiversity and in improving the water quality (see appendix A for the full text of the testimonial). In the written information, the participants viewed some of the major functions of native plants in providing biodiversity and reducing nutrient pollution. Participants in the control group only viewed the written information without the testimonial.

Table 3   Summary of the between subject treatments

Group type	Written Information	Video Testimonial
Control group	Yes	No
Treatment group	Yes	Yes

After viewing the written information with or without the video testimonial, all participants had the opportunity to use some of their $10 to buy a bundle of three native plants- they could either keep the entire $10 or use that to buy Penstemon digitalis 'Husker Red', a perennial native plant (see appendix D for a picture of the husker red plant). They were shown three prices ($0, $3, $6) for a bundle of three plugs of the native plant i.e. ($0, $1, and $2) per plug. These prices were chosen in line with the existing market price for these plugs. The participants indicated whether

11

they were willing to buy the plants at each of these three listed prices through a series of yes/no questions, also known as dichotomous choice questions. To avoid any order effect, these prices were presented to the participants in random order. Finally, one of the three choices were randomly selected at the end for implementation. If the participant indicated that they were willing to buy the plant at the randomly selected choice at the corresponding price, the participant had to purchase the plants. Instead, had the participant indicated that they were not willing to buy the plant in the randomly selected choice at the corresponding price, the participant did not get the plant for purchase. Hence, the participants' choices were binding making their plant purchasing decisions incentive compatible. At the end, all participants answered a short survey regarding their demographic and socio-economic characteristics as well as their environmental concerns (see appendix B).

The advantage of using dichotomous choice questions to elicit preferences, is that they provide a realistic market situation. It resembles real choices a consumer may face. For instance, each purchasing question that the participant responds to represents a real-life decision they would have faced had they seen a plant for sale at a nursery at a posted price. As a result, Arrow et al. (1993), recommends using dichotomous choice questions to elicit preferences. In addition, Wu et al. (2017) shows that dichotomous choice designs provide a better estimate of the willingness to pay compared to auction designs such as BDM, because they are more realistic. However, dichotomous choice experiments require more data to generate the same conclusion regarding willingness to pay estimates compared to other auction mechanisms. Therefore, we recruited 309 participants for this study to address this drawback of our design.

There was no communication among participants during the study to ensure that the participants' responses represented their own preference. During the community event, participants were seated quite close to each other. Hence, they were seated in desks separated by privacy shields to avoid any form of communication. At the mall and at the University of Delaware creamery, participants were seated far from each other, making communication unlikely. In addition, the study did not involve deception. The plants used were Penstemon digitalis 'Husker Red', the perennial native plant as described in the experiment. Furthermore, all the information provided to the participants were true.

Chapter 4

METHODOLOGY

Participants made decisions over a series of yes/no purchasing decisions for native plants at various prices. Some participants received a testimonial and others did not. Let $D = \{0,1\}$ represent an individual's decision set in which the participant either chose "yes" ($D = 1$) or chose "no" ($D = 0$). The participant will buy the good only if her WTP was greater than or equal to the listed price (P) and does not buy the good if her WTP was less than the listed price (P). Therefore,

$$D = \begin{cases} 0 & WTP < P & \text{(No − does not buy at price P)} \\ 1 & WTP \geq P & \text{(Yes − buys the good at price P)}. \end{cases} \quad (1)$$

The corresponding probabilities can be written as:

$$\Pr(Y = D) = \begin{cases} F\big(v(P, X, Z)\big) \\ 1 - F\big(v(P, X, Z)\big) \end{cases} \text{for D} = \begin{cases} 0 \\ 1 \end{cases} \quad (2)$$

Here, $F\big(v(P, X, Z)\big)$ is the cumulative probability distribution function where, P is the price, X is a vector of observable demographic and socioeconomic characteristics, and Z is an attribute of the product. In our study Z is a dummy variable where,

$$Z = \begin{cases} 0 \text{ if participant does receive the audiovisual testimonial video} \\ 1 \text{ if participant receives the audiovisual testimonial video} \end{cases} \quad (3)$$

The cumulative probability function $F(.)$, in equation (3), is a function of $v(.)$, as shown in equation (4), which is the indirect utility function measuring the utility gain from buying the product at a given P, X, and Z:

$$v(P, X, Z) = \lambda_0 + \lambda_1 P + \lambda_2 X + \lambda_3 Z + \varepsilon \qquad (4)$$

Here, ε is the stochastic error term. The λs are the unknown parameters to be estimated. λ_1, λ_2 are changes in the indirect utility due to a unit change in P and X and λ_3 represents change in the utility due to receiving the audiovisual testimonial. The resulting log-likelihood function is given by:

$$\ln L = \sum_{i=1}^{n} I_{Y_{D=0}} \ln F\left(v(P, X, Z)\right) + I_{Y_{D=1}} \ln[1 - F(v(P, X, Z))] \quad (5)$$

Where, $I_{Y_{D=\{0,1\}}}$ is an indicator variable for an individual, where $I = 1$ if $D = 1$ and $I = 0$ if $D = 0$, as defined in equation (1).

Furthermore, the marginal effect on willingness to pay (MEWTP) for each of the demographic and socioeconomic characteristics, and the testimonial is estimated by dividing the coefficient for each of these variables' corresponding coefficient from equation (5) by the negative of the price coefficient from the same equation. It is estimated using the following formula:

$$MEWTP_j = -\frac{1}{\widehat{\lambda_1}}\left(\widehat{\lambda_j}\right) \text{ where } j = 2,3 \qquad (6)$$

Where, $\widehat{\lambda_1}$ is the estimated coefficient for price in equation (5), and $\widehat{\lambda_j}$ is the estimated coefficient for each X and that for Z.

In addition, the standardized MEWTP for each of the demographic and socioeconomic characteristics, and the testimonial is estimated by dividing the MEWTP estimate for each of these variables, using equation 6, by the standard error of the corresponding MEWTP. It is estimated using the following formula:

$$MEWTP_j = \frac{MEWTP_j}{standard\ error\ of\ MEWTP_j} \quad where\ j = 2,3 \qquad (7)$$

Finally, average willingness to pay will be calculated using Hanemann (1984)

formula:

$$WTP = \frac{1}{\widehat{\lambda_1}}\left(\widehat{\lambda_0} + \widehat{\lambda_2}\overline{X} + \widehat{\lambda_3}\bar{Z}\right) \qquad (8)$$

where $\widehat{\lambda_1}$ is an absolute value representing the price coefficient, $\widehat{\lambda_0}, \widehat{\lambda_2}, and\ \widehat{\lambda_3}$ are the

estimated intercept and the coefficient parameters for X and Z from equation (5), and $\overline{X}$

is a vector of the means of all the explanatory variables except testimonial and $\bar{Z}$ is the

mean of the indicator variable for the testimonial.

Chapter 5

RESULTS

In total 309 participants took part in this study. Of the 309 participants, 155 participants (50.16%) received a testimonial i.e. were in the treatment group, and 154 (49.84%) participants did not receive the video testimonial i.e. were in the control group. This distribution (see table 4) shows that the participants were randomly assigned to either the control or the treatment group.

Table 4   Distribution of participants in control and treatment group

	Count	Percentage
Control Group: Did not receive video testimonial	154	49.84%
Treatment Group: Received video testimonial	155	50.16%
Total	309	100%

Descriptive Statistics

Of all the participants, 95% were residents from the mid-Atlantic states (73% from Delaware, 9% from Pennsylvania, 7% from Maryland, and 5% from New Jersey). The rest 5% participants were residents from a variety of other states including Colorado, Connecticut, Virginia, Ohio, New York etc. with each state having an insignificant number of participants.

A summary of the selected survey responses of the participants is shown in table 5 and 6. Table 5 reports summary statistics of the participants' demographic and socioeconomic characteristics. The average age of the participants was 41 years. Males comprised of a smaller proportion of the participants (45%). Majority of the participants lived in a suburban area (76%), followed by rural area (13%), and urban area (11%). Most of the participants owned their own house (68%). In addition,

participants come from various racial backgrounds. Majority of the participants identify themselves as Whites (74%), followed by Asian (9%), Black (7%), Hispanics (5%), and various other racial backgrounds (5%). Furthermore, 42% of the participants lived in a household with at least one child less than 18 years old.

Table 5   Summary statistics for selected socioeconomic characteristics

Variable	Mean/percentage of respondents
Age (years)	41
Gender (1=Male, 0=Female)	45%
Area type: Rural Suburban Urban	 13% 76% 11%
House type (1=Owned, 2=Rented)	68
Children (under 18 years old) (1= at least 1, 0= no children)	42%
Ethnicity: White, Not Hispanic Hispanic Black Asian Others	 74% 5% 7% 9% 5%
Income: Less than US$ 25,000 US$ 25,000- US$ 49,999 US$ 50,000- US$ 74,999 US$ 75,000- US$ 99,999 US$ 100,000- US$ 149,999 US$ 150,000- US$ 199, 000 Greater than US$ 200, 000	 16% 16% 21% 15% 21% 6% 6%
Variable	Mean/percentage of respondents
Employment Status: Employed Retired Stay at home caregiver Student Not employed	 66% 8% 7% 17% 2%

Education:	
High school graduate or equivalent	8%
Some college but no degree	19%
Associate degree	6%
Bachelor's degree	39%
Graduate degree	28%
Political belief:	
Politically Conservative	17%
Politically Moderate	35%
Politically Liberal	38%
Others	10%
Lawn Size:	
Less than 0.25 acres	42%
0.25 acre- 0.50 acre	30%
0.51 acre- 1 acre	15%
1 acre- 2 acres	7%
Greater than 2 acres	6%
Lawn managed by:	
Self	89%
Someone else in the family	5%
Manager/owner	2%
Others	4%
Uses environmentally friendly lawn care practices (1=Yes, 0= No)	84%

The income distribution of the participants is slightly skewed. Most of the participants were employed (66%), followed by students (17%). The rest were retired (8%), stay at home caregiver (7%), and unemployed (2%) respectively. Majority of the participants (73%) had some form of a college degree (associates, bachelor's or graduate). Participants' political beliefs were diverse; 38% participants identified themselves as politically liberal, followed by politically moderate (35%), and politically conservative (17%) respectively. Majority of the participants managed their lawns by themselves (89%), which was a key exclusion criterion for this study. Finally, 84% of the participants used at least one of the listed lawn care BMPs showing prior engagement with pro-environmental BMPs. The listed BMPs included-

testing soil nutrient, following fertilizer recommendations, following water

conservation practices (e.g. soaker hoses, drip irrigation), using soil amendments (e.g.

biochar, peat moss), using native plants, and/or using rain barrels.

Table 6 reports the participants reported environmental concerns. Majority of

the participants (84%) used at least one of the listed products. In addition, participants

were also asked about their concern for water quality, habitat for beneficial animals,

and biodiversity. The responses were recorded in four categories: Not concerned,

Somewhat Concerned, Very Concerned, and Unsure. A small proportion of

participants showed little concern or were unsure about water quality, habitat for

beneficial animals, and biodiversity. Majority of them reported Somewhat or Very

Concerned about these environmental issues.

Table 6   Summary statistics for participant's environmental concern

Variable	Mean/percentage of respondents
Concern about water quality:	
Not Concerned	9%
Somewhat concerned	34%
Very Concerned	55%
Not sure	2%
Concern about Biodiversity:	
Not Concerned	12%
Somewhat concerned	46%
Very Concerned	35%
Not sure	6%
Concern about habitat for beneficial animals:	
Not Concerned	
Somewhat concerned	8%
Very Concerned	34%
Not sure	55%

	3%

Each of the 309 participants made a yes/no decision regarding the purchase of native plants at three posted prices ($0, $3, $6) for a bundle of three native plants. This resulted in 927 purchasing decisions in total. The percentage of participants purchasing at each of these prices is shown in table 7. It is observed that the percentage of participants deciding to purchase the plants falls as price increases depicting the law of demand. Clearly, price is a key variable in determining the participants' likelihood of purchasing a native plant.

Table 7   Percentage of purchases at each of the posted prices

Details	Percentage of participants at each price
Purchased at price=0	79%
Purchased at price=3	48%
Purchased at price=6	26%

Random Effect Logistic Regression and the Marginal Effect on Willingness to Pay

We will conduct econometric analysis of our data to test our hypothesis in table 1. Given the panel nature of our data, we test our hypothesis by estimating a random effect logistic regression and the corresponding standardized and dollar value of the MEWTP for each of the pertinent explanatory variables using equations 6 and 7 respectively. We examine the impact of testimonials using three sets of models: (i) without controlling for the demographic and socioeconomic characteristics; (ii) by controlling for the demographic and socioeconomic characteristics of the participants; (iii) by controlling for both the demographic and socioeconomic characteristics and interacting them with the treatment variable. Our conclusions will however be drawn

based on the second model as the results make more intuitive sense, making the model pertinent for our analysis. Definition of all the variables used for the following analysis is provided in the appendix C.

Model I

We begin our analysis by first analyzing the purchasing decisions, without controlling for the participants' demographic and socio-economic characteristics. Results for the random effect logistic regression, as shown in equation 5, only controlling for price and testimonial is reported in table 8 column (1) and the corresponding standard errors for the coefficients is reported in column (2) of table 8. Unsurprisingly, price matters. It is statistically significant at 1% level of significance. The coefficient of the price variable is negative, indicating that a unit increase in the price decreases the likelihood of purchasing the bundle of native plants. This finding is in line with the law of demand.

Table 8   Random effect logistic regression parameters without controlling for demographic characteristics and environmental concerns

	Coefficient (1)	Std. Err. (2)
Price	-0.66***	0.06
Testimonial	0.15	0.30
Constant	1.99	0.28
N=927		

*** Significant at 1% level. **Significant at 5% level. *Significant at 10% level

The key focus of this study is to find the impact of testimonials on the purchasing decisions of the participants and on their willingness to pay for the pro-environmental technology. From the random effect logistic regression, we observe that

22

testimonials do not have a statistically significant impact on the participants'
purchasing decisions when we are not controlling for the demographic and socio-
economic characteristics of the participants. The standardized and the dollar value of
the MEWTP (estimated using equation 6 and 7 respectively) is not statistically
significant at the standardized levels of significance. The dollar and standardized
values of the MEWTP are reported in table 9, column (1) and (2) respectively. This
shows that we cannot reject our null hypothesis, i.e. participants receiving the video
testimonial did not exhibit a statistically significant difference in the WTP for the
native plants.

Table 9   MEWTP of relevant variables without controlling for demographic
            characteristics and environmental concerns

	MEWTP (1)	Standardized MEWTP (2)
Testimonial	0.23	0.5
N=927		

 *** Significant at 1% level. **Significant at 5% level. *Significant at 10% level

Model II

We next, shed light on the purchasing decisions and the willingness to pay for
the pro-environmental technology, controlling for the demographic and socio-
economic characteristics. The resulting random effect logistic regression (estimated
using equation 5) and the corresponding standard errors are reported in table 10
column 1 and 2 respectively. The corresponding dollar value and standardized value
for MEWTP (estimated using equation 6 and 7 respectively), are reported in table 11
column 1 and 2 respectively. In line with our previous analysis, price matters even

after controlling for the demographic and socioeconomic characteristics of the participants. The price coefficient is negative and is statistically significant at 1% level, indicating that an increase in the unit price decreases the likelihood of purchasing the bundle of native plants.

Many of the standard demographic characteristics showed a statistically significant impact on the MEWTP for native plants at the standard levels of significance. A one-year increase in age reduced the MEWTP by $0.05 and the standardized MEWTP by 3.05. These estimates are statistically significant at 1% level. In addition, a unit increase in income increased the MEWTP by $0.30 and the standardized MEWTP by 2.02. These estimates are significant at 5% level. Furthermore, an increase in the lawn size increased the participants' MEWTP by $0.35 and their standardized MEWTP by 1.76. Finally, participants using one or more of the posted pro-environmental BMPs exhibited a higher MEWTP of $1.16 and standardized MEWTP of 1.83 compared to participants not using. These estimates are significant at 10% level. These findings make intuitive sense and provide the rationale for controlling the demographic and socio-economic characteristics of the participants. In addition, they are policy relevant – they are pointing the target groups for making pro-environmental interventions relating lawn care BMPs.

Despite controlling for the demographic and socioeconomic characteristics, we find that our target intervention, the audiovisual testimonial, did not have a statistically significant impact on the participants' willingness to pay. Therefore, we fail to reject our null hypothesis, reported in table 1, despite controlling for the demographic and socioeconomic characteristics of the participants.

Table 10   Random effect logistic regression parameters controlling for demographic and socio-economic characteristics.

	Coefficient (1)	Std. Err. (2)
Price	-0.66***	0.06
Testimonial	0.18	0.30
Age	-0.03**	0.01
Children	-0.38	0.32
Gender	0.11	0.30
Income	0.20**	0.10
Education	0.11	0.12
Lawn size	0.23*	0.13
Pro-environmental Lawn Practice	0.76*	0.42
_cons	1.24*	0.74
N=927		

*** Significant at 1% level. **Significant at 5% level. *Significant at 10% level

Table 11   MEWTP of relevant variables controlling for demographic characteristics and environmental concerns

	MEWTP ($) (1)	Standardized MEWTP (2)
Testimonial	0.27	0.59
Age	-0.05**	-3.05**
Children	-0.59	-1.22
Gender	0.17	0.37
Income	0.30**	2.02**
Education	0.16	0.89
Lawn size	0.35*	1.76*
Pro-environmental Lawn Practice	1.16*	1.83*
N=927		

*** Significant at 1% level. **Significant at 5% level. *Significant at 10% level

Model III

We finally, analyze the participants' purchasing decisions and their willingness to pay, controlling for the demographic and socio-economic characteristics of the participants but this time, also controlling for the interaction among the treatment variable testimonial with the socio-economic and demographic characteristics to check if testimonial had any differential impact for any of the participants' stated characteristics. The estimated coefficients for the resulting random effect logistic regression using equation (5) and the corresponding standard errors are reported in table 12 column (1) and (2) respectively. The corresponding MEWTP and standardized MEWTP, computed using equation (6) and (7), is reported in table 13 column 1 and 2 respectively.

Table 12   Random effect logistic regression parameters controlling for
            demographic and socio-economic characteristics with interaction.

	Coefficient (1)	Std. Err. (2)
Price	-0.66***	0.06
Testimonial (T)	-1.00	1.43
Age	-0.04**	0.02
Age x T	0.02	0.02
Children	-0.87*	0.45
Children x T	0.94	0.64
Gender	0.04	0.44
Gender x T	0.18	0.61
Income	0.23	0.15
Income x T	-0.05	0.20

Education	0.06	0.16
Education x T	0.12	0.24
Lawn size	0.26	0.18
Lawn size x T	-0.06	0.26
Pro-environmental Lawn Practice	0.97*	0.59
Pro-environmental Lawn Practice x T	-0.36	0.84
Constant	1.71*	1.02

*** Significant at 1% level. **Significant at 5% level. *Significant at 10% level

Findings from this analysis shows that in line with the previous analysis, a unit increase in the price reduces the participants' likelihood of purchase and is statistically significant at 1% level. In addition, some of the demographic and socio-economic characteristics from model II are statistically significant in model III and have the same sign. However, none of the interaction terms had any statistically significant impact on the participants' MEWTP and their likelihood of purchase. Hence, controlling for the interaction terms is not necessary in this analysis. Consequently, we will use model II to make any further conclusions regarding this study.

Table 13   MEWTP of relevant variables controlling for demographic characteristics and environmental concerns and interaction

	MEWTP $ (1)	Standardized MEWTP (2)
Testimonial (T)	-1.53	-0.70
Age	-0.07**	-2.76**
Age x T	0.03	1.01
Children	-1.32*	-1.91*
Children x T	1.44	1.50
Gender	0.07	0.10

|		
Gender x T	0.27	0.29
Income	0.35	1.57
Income x T	-0.08	-0.26
Education	0.10	0.38
Education x T	0.18	0.49
Lawn size	0.40	1.43
Lawn size x T	-0.09	-0.22
Pro-environmental Lawn Practice	1.47*	1.63*
Pro-environmental Lawn Practice x T	-0.54	-0.43

*** Significant at 1% level. **Significant at 5% level. *Significant at 10% level

Average Willingness to Pay

We estimate the average willingness to pay for a bundle of native plants using equation 8. We find that participants in the control and the treatment group had almost identical average willingness to pay for a bundle of three Husker Red plugs. Participants in the treatment group, i.e. receiving the testimonial, had an average willingness to pay of $3.51 and those in the control group had an average willingness to pay of $3.53. These estimates are reported in figure 1.

Figure 1   Average Willingness to Pay for the control and treatment group
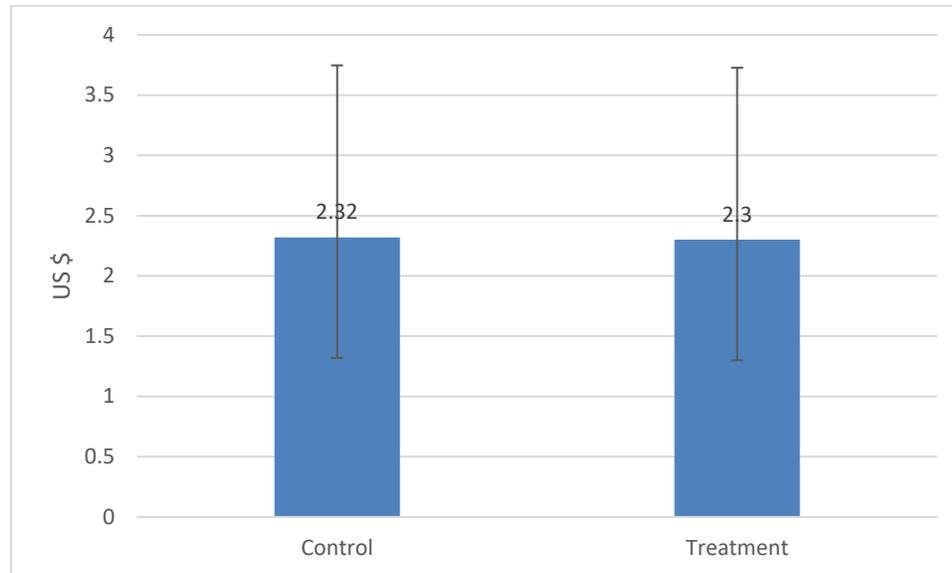
Note: Error bars represent 95% Confidence Interval for WTP measures obtained through delta method.

Discussion

We use results from model II to make basic conclusions as none of the interactions terms were statistically significant in model III. The results indicate that several demographic and socio-economic characteristics of the participants had a statistically significant impact on the participants purchasing decision and their MEWTP. The significant MEWTP from model II are presented in figure 2 below. These estimates indicate the target group for pro-environmental interventions. We find that a unit increase in the participants' age reduces their MEWTP by $0.05. Prior experience with pro-environmental BMPs had the most impact on the participants MEWTP.

Figure 2   Significant MEWTP of demographic and socio-economic characteristics
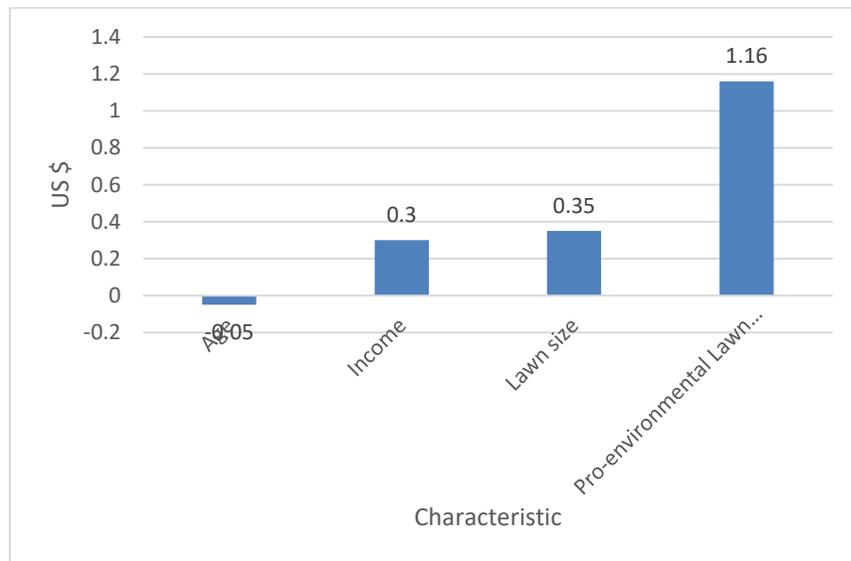
In addition, the treatment variable, testimonial, did not bring a statistically significant change in the participants purchasing decisions and their willingness to pay for native plants. However, this conclusion is contingent upon the assumptions undertaken for this study. This study will be able to detect an effect size greater than $1.5 if it exists. Therefore, the findings warrant further investigation with a larger sample size capable of detecting smaller effect sizes, which we could not undertake due to logistic challenges.

Chapter 6

CONCLUSION

Given the considerable evidence about testimonials being a cost-effective marketing strategy for consumer goods, it is important to understand whether testimonials can promote pro-environmental practices. Therefore, this study was designed as a single-bounded, dichotomous choice, and incentive compatible framed field experiment to elicit the impact of an audio-visual expert testimonial on consumers' willingness to pay for native plants as a pro-environmental practice. In conjunction with providing insights on participants' willingness to pay, this study also conducted a power analysis to find the sample size required to detect the treatment effect. This study is sufficiently powered to detect a treatment effect of $1.50. In addition, this study provides the statistical power for a range of sample sizes and effect sizes to facilitate future researchers in this area.

The findings from this study are policy relevant. The key finding of this study is that audio-visual expert testimonials failed to bring any statistically significant change in participants' willingness to pay for the pro-environmental practice at the standard levels of significance. This result is in line with earlier research that shows that promoting conservation behavior by simply providing information could be futile. Although, testimonials are seen as an effective marketing strategy, results from this sufficiently powered study shows that testimonials are ineffective in promoting pro-environmental behavior. Finally, several key demographic and socioeconomic characteristics of the participants affect participants' willingness to pay for the pro-environmental practice. These findings indicate a target population for conservation outreach programs.

Further research in the area could explore the use of behavioral nudges such as social norms, or emotions to understand whether incorporating such nudges within testimonials could bolster the impact of testimonials on encouraging pro-environmental behaviors.

Finally, this study is well-powered to detect an effect size greater than $1.5. Our study, however, is not well-powered to detect an effect size less than $1.5. Further research could be conducted in the area with a larger sample size that is capable of detecting a smaller effect size, should it exist to check if testimonials could bring any change in participants' willingness to pay for pro-environmental practices.

REFERENCES

1. Appiah, Osei. "Rich Media, poor Media: The Impact of audio/video vs. text/picture testimonial ads on browsers' evaluations of commercial web sites and online products." *Journal of Current Issues & Research in Advertising* 28, no. 1 (2006): 73-86.

2. Arrow, K., Solow, R., Portney, P. R., Leamer, E. E., Radner, R., & Schuman, H. (1993). Report of the NOAA panel on contingent valuation. *Federal register*, *58*(10), 4601-4614.

3. Biswas, Dipayan, Abhijit Biswas, and Neel Das. "The differential effects of celebrity and expert endorsements on consumer risk perceptions. The role of consumer knowledge, perceived congruency, and product technology orientation." *Journal of advertising* 35, no. 2 (2006): 17-31.

4. Bly, Robert W. (2005), "More Tips on Using Testimonials," available at http://marketingtoday.com/marcom/testi2.htm (accessed April 17, 2019).

5. Chaiken, Shelly, and Alice H. Eagly. "Communication modality as a determinant of persuasion: The role of communicator salience." *Journal of personality and social psychology* 45, no. 2 (1983): 241.

6. Chan, Kara KW. "Chinese viewers' perception of informative and emotional advertising." *International Journal of Advertising* 15, no. 2 (1996): 152-166.

7. Coyle, James R., and Esther Thorson. "The effects of progressive levels of interactivity and vividness in web marketing sites." *Journal of advertising* 30, no. 3 (2001): 65-77.

8. EPA (2002). "Landscaping with Native Plants." Accessed August 2018 at https://www.waterfordmi.gov/DocumentCenter/View/587/Landscaping-with-Native-Plants-PDF.

9. EPA (2003). "Greenacres: Landscaping with Native Plants." Accessed March 2018 at https://archive.epa.gov/greenacres/web/html/index.html.

10. Ester, P., & Winnet, R. A. (1982). Toward more effective antecedent strategies for environmental programs. *J. ENVIRON. SYS.*, *11*(3), 201-222.

11. Feick, Lawrence, and Robin A. Higie. "The effects of preference heterogeneity and source characteristics on ad processing and judgements about endorsers." *Journal of Advertising* 21, no. 2 (1992): 9-24.

12.   Frederiks, Elisha R., Karen Stenner, and Elizabeth V. Hobman. "Household energy use: Applying behavioural economics to understand consumer decision-making and behaviour." *Renewable and Sustainable Energy Reviews* 41 (2015): 1385-1394.

13.   Friedman, Hershey H., and Linda Friedman. "Endorser effectiveness by product type." *Journal of advertising research*(1979).

14.   Ioannidis, J. P., Stanley, T. D., & Doucouliagos, H. (2017). The power of bias in economics research.

15.   Jason, L. A., Zolik, E. S., & Matese, F. J. (1979). Prompting dog owners to pick up dog droppings. *American Journal of Community Psychology*, *7*(3), 339-351.

16.   Kemp, Elyria, Kim H. Williams, and McDowell Porter III. "Hope across the seas: the role of emotions and risk propensity in medical tourism advertising." *International Journal of Advertising* 34, no. 4 (2015): 621-640.

17.   Li, Hairong, Terry Daugherty, and Frank Biocca. "Impact of 3-D advertising on product knowledge, brand attitude, and purchase intention: The mediating role of presence." *Journal of advertising* 31, no. 3 (2002): 43-57.

18.   Martin, Brett AS, Daniel Wentzel, and Torsten Tomczak. "Effects of susceptibility to normative influence and type of testimonial on attitudes toward print advertising." *Journal of advertising* 37, no. 1 (2008): 29-43.

19.   Martin, Brett AS, Kai Zhan, Ying Xian Wang, and Hyun Seung Jin. "The influence of entitlement and envy on tourist judgments of missed benefits." *Journal of Hospitality and Tourism Management* 38 (2019): 58-65.

20.   Palm-Forster, L. H., Ferraro, P. J., Janusch, N., Vossler, C. A., & Messer, K. D. (2019). Behavioral and Experimental Agri-Environmental Research: Methodological Challenges, Literature Gaps, and Recommendations. *Environmental and Resource Economics*, 1-24.

21.   Petty, Richard E., John T. Cacioppo, and David Schumann. "Central and peripheral routes to advertising effectiveness: The moderating role of involvement." *Journal of consumer research* 10, no. 2 (1983): 135-146.

22. Raju, Sekar, Priyali Rajagopal, and H. Rao Unnava. "Attitude toward a comparative advertisement: the role of an endorser." *ACR North American Advances* (2002).

23. Shapiro, Stewart, and Mark T. Spence. "Factors affecting encoding, retrieval, and alignment of sensory attributes in a memory-based brand choice task." *Journal of Consumer Research* 28, no. 4 (2002): 603-617.

24. Shimp, Terence A., Stacy L. Wood, and Laura Smarandescu (2005), "Consumer Testimonials as Self-Generated Advertisements: Evaluative Reconstruction Following Product Usage," *MSI Reports,* 2 (05–109), 91–113.

25. Singh, Jagdip, Leona Cuttler, and J. B. Silvers. "Toward understanding consumers' role in medical decisions for emerging treatments: Issues, framework and hypotheses." *Journal of Business Research* 57, no. 9 (2004): 1054-1065.

26. Stern, P. C. (1992). Psychological dimensions of global environmental change. *Annual review of psychology*, *43*(1), 269-302.

27. Tedeschi, James T., and Thomas V. Bonoma. "Power and influence: An introduction." *The social influence process*(1972): 1-49.

28. Winett, R. A., Hatcher, J. W., Fort, T. R., Leckliter, I. N., Love, S. Q., Riley, A. W., & Fishback, J. F. (1982). The effects of videotape modeling and daily feedback on residential electricity conservation, home temperature and humidity, perceived comfort, and clothing worn: Winter and summer. *Journal of Applied Behavior Analysis*, *15*(3), 381-402.

29. Wright, Alice A., and John G. Lynch Jr. "Communication effects of advertising versus direct experience when both search and experience attributes are present." *Journal of consumer research* 21, no. 4 (1995): 708-718.

30. Wu, S., Fooks, J., Messer, K. D., Li, T., & Delaney, D. (2017). Auction versus posted price in experiments: Comparisons of mean and marginal effect.

Appendix A

FULL TEXT OF THE AUDIO-VISUAL TESTIMONIAL

Doug Tallamy, Entomology and Wildlife Ecology: The ability for ecosystem function in our manages landscape and our urban suburban matrix is very poor. Because we have landscape primarily for looks, we have treated plants as if they were decorations and forgotten all about their ecological roles. So, we have sacrificed the ability of all the lands we have used for our suburban neighborhoods. To make ecosystem services that not only support other creatures, but they support us as well. If you produce plants that insects cannot reproduce on and develop on you are creating a really deep-rooted ecosystem. What this homeowner has done is put the plants back in the suburban landscape. Most of these plants are indigenous, they are native to this area which means they are important components of the food webs that were originally in this area. So, you have lots of wildlife, these plants are filtering our water there and sequestering carbon, they are supporting the food webs, they are supporting the pollinators to keep those plants around, they are producing oxygen. All of the ecosystem services the plants provide are now happening right in this yard because it is not one vast lawn. I care about this because we need these other living things to run the ecosystems that we depend on as humans. So, we can think of this as: we are not making a sacrifice. We are doing what's absolutely necessary to keep ecosystem running that support us. So, it's for human. (University of Delaware Research)

Appendix B

SURVEY QUESTIONS

Please answer the following questions:

1. In what year you were born? [Select a year ▾]

2. Who makes decisions about your lawn?

   ◯ I do

   ◯ Someone else in my household does

   ◯ My property manager/owner does

   ◯ Other (please specify) [other]

3. What is your gender?

   ◯ Male

   ◯ Female

   ◯ Prefer not to answer

4. Which best describes the community that you live in?

   ◯ Rural

   ◯ Urban

   ◯ Suburban

5. Do you rent or own your own house?

   ◯ Rent

   ◯ Own

6. How many acres is your lawn? Please consider the area of your property that is comprised of grass, shrubs, and other plants. For comparison, a football field is approximately 1 acre.

   ◯ I do not have a lawn

   ◯ Less than 1/4 acre

   ◯ 1/4 - 0.99 acre

   ◯ 1 - 2 acres

   ◯ More than 2 acres

7. How many adults live in your household?

8. How many children (under 18 years old) live in your household?

9. What is your ZIP code?

10. Which best describes your employment status?

   ○ Not employed

   ○ Employed

   ○ Retired

   ○ Student

   ○ Stay at home parent/caregiver

11. Are you:

   ○ Politically liberal

   ○ Politically moderate

   ○ Politically conservative

   ○ Other (please specify) [other]

12. What best describes your ethnicity?

   ○ White (not Hispanic)

   ○ Hispanic

   ○ Black

   ○ Asian

   ○ Other (please specify) [other]

13. Which category best describes your <u>household</u> income (before taxes) in 2017?

○ Less than $25,000

○ $25,000-$44,999

○ $50,000-$74,999

○ $75,000-$99,999

○ $100,000-$149,999

○ $150,000-$199,999

○ $200,000 and above

14. What is the highest level of education that you have completed?

○ Less than high school

○ High school graduate or equivalent (i.e.GED)

○ Some college, but no degree

○ Associate degree

○ Bachelor's degree

○ Graduate degree or professional degree

15. How concerned are you about the impact of your lawn care and landscaping decisions on the following factors?

	Not Concerned	Somewhat concerned	Very concerned	Not sure
Water Quality	○	○	○	○
Biodiversity	○	○	○	○
Habitat for beneficial animals (ex: honey bees)	○	○	○	○

16. Do you use any of the following environmentally-friendly practices at your home?

☐ Soil nutrient testing
☐ Follow fertilizer recommendations
☐ Water conservation practices (ex. soaker hoses, drip irrigation)
☐ Soil amendments (ex. biochar, peat moss)
☐ Native plants
☐ Rain barrels
☐ Other _____

17. Have you heard about the Delaware Livable Lawns Program?

○ Yes, but I am *not* participant

○ Yes, I have enrolled my lawn in the program

○ No, I have not heard of it

Continue

Appendix C

DEFINITION OF THE VARIABLES

Price	Continuous Variable; one of the randomly posted prices
Age	Continuous variable in years
Gender	Dummy Variable coded: 1=Male; 0=Female
Children	Dummy Variable coded: 1= "at least 1child under 18 years old"; 0= 'no children under 18 years old'.
Income	Continuous Variable coded: 1= "Less than US$ 25,000"; 2= "US$ 25,000- US$ 49,999"; 3= "US$ 50,000- US$ 74,999"; 4= "US$ 75,000- US$ 99,999"; 5= "US$ 100,000- US$ 149,999"; 6= "US$ 150,000- US$ 199, 000"; 7= "Greater than US$ 200, 000"
Education	Continuous Variable coded: 1= "High school graduate or equivalent" 2= "Some college but no degree" 3= "Associate degree" 4= "Bachelor's degree" 5= "Graduate degree"
Lawn Size:	Continuous Variable coded: 1= "Less than 0.25 acres" 2= "0.25 acre- 0.50 acre" 3= "0.51 acre- 1 acre" 4= "1 acre- 2 acres" 5= "Greater than 2 acres"
Uses environmentally friendly lawn care practices (1=Yes, 0= No)	Dummy Variable coded: 1=Yes; 0=No

Appendix D

IMAGES

Figure 3   Penstemon digitalis 'Husker Red' is a plant that is native to the Eastern U.S. It is an attractive, hardy plant that can grow in sun or shade, and it is pest resistant.

Figure 4   Three 'Husker Red' landscape plugs were distributed with care information and relevant instructions (left) at experiment locations, like the Christiana Mall in Newark, DE (right).