# CONSUMER PREFERENCE FOR PACKAGING MATERIALS: WILLINGNESS TO PAY AND BARRIERS TO RECYCLING

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## ABSTRACT

## CONSUMER PREFERENCE FOR PACKAGING MATERIAL: WILLINGNESS TO PAY AND BARRIERS TO RECYCLING

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This study focuses on the application of a stated preference elicitation method to assess consumer preferences for packaging recyclability. In collaboration with top executives from food companies, a survey was developed in order to obtain current recycling habits from an online sample of 2,000 respondents, who self identified as the primary household decision-maker and grocery shopper. Two choice experiments were used to determine consumer willingness to pay (WTP) for packaging recyclability and barriers to recycling. This study contributes to the literature on individual packaging and its components that increase or hinder recycling. The effectiveness of indirect questioning and information treatments on influencing consumer behavior was also analyzed using a between subject design. Our results show an average positive willingness to pay for packaging recyclability, with a fraction of respondents having an estimated negative willingness to pay. Willingness to accept to clean in order to recycle has significant and positive for all treatment groups. The analysis of the information treatments showed that consumers were responsive to the video treatment by increasing their WTP for packaging recyclability, but not responsive to the infographic treatment. Evidence of social desirability bias was found in this analysis, suggesting more scrutiny should be placed on estimates that do not address social desirability bias.

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# 1. Introduction

## 1.1 Motivation

Total household trash generated in the United States is at an all time high (EPA, 2015), which poses environmental problems and wastes resources. Some of this increase can be attributed to the amount of packaging each household consumes. Recycling has been proposed as part of the solution to increasing trash problem. According to the EPA (2015), although the total amount of household waste that is recycled has been steadily increasing since the 1960s, the percent of household waste that is recycled has stagnated in recent years (Figure 1).

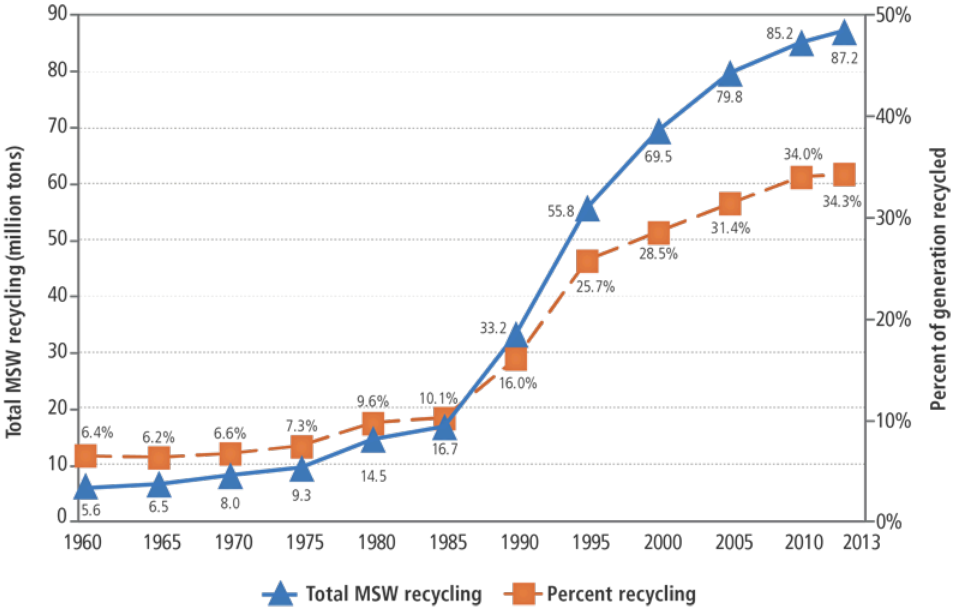


Figure 1: Municipal Solid Waste Recycling Rates, 1960-2013
*Source: EPA, 2015*

As the amount of packaging consumed has increased, companies are pressured to take responsibility for the entire life cycle of their product packaging. Companies have responded by promoting increasing recycling of their packaging materials. For example, Coca-Cola has released a green leaf recycling logo for their products in an effort to promote recycling behavior. Even though there has been an increase in overall packaging recycling, the percent of packaging

that is recycled has remained stagnant in recent years. Previous research has mainly focused on cumulative recycling habits, with relatively little work available on product-specific recycling.

### 1.2 Research Questions

In this study, information was collected about U.S. consumer preferences for packaging recyclability. In an online survey, answers were collected from consumers concerning their knowledge about recycling, motives for recycling, and socio-demographic information. The following hypotheses guide this study:

1) Consumers receive positive utility from packaging recyclability, resulting in an increase in consumer willingness to pay for the packaging and thus the entire product; and 2) Consumers are willing to make tradeoffs between the benefits they gain from recycling and the effort and time needed to recycle.

Since companies and policy makers have used commercials and recycling logos to support increased recycling, we test the effects of a video and an infographic to determine the effectiveness of certain information treatments on consumer valuation of recycling. This study also used a survey technique called indirect questioning to address issues of hypothetical bias in stated preference choice experiments.

### 1.3 Objective

The objective of this thesis is to estimate demand for packaging recyclability for different materials. The purpose of this analysis is to help food, beverage, and packaging companies develop packaging strategies to improve consumer willingness to recycle. This information can also benefit the recycling industry as a whole by specifying factors that negatively affect consumer's recycling behavior. With the results of this study, government officials, waste

management companies, and packaging companies can select proper channels to incentivize consumers to recycle.

### 1.4 Thesis Structure

This Thesis is comprised of 7 chapters and is organized as follows: Chapter 2 presents background information on consumer preference for recycling and packaging. Chapter 3 provides theory concerning the experiments used in this thesis. Chapter 4 describes the data presented in this study. Chapter 5 incorporates the data methods used in this study. Chapter 6 presents the results and analysis of this study. Chapter 7 reviews findings and suggests discussion points for future research. Supplemental documents are presented in the appendix.

## 2. Literature Review

This chapter reviews both empirical and theoretical research in consumer attitudes and behaviors concerning recycling. Although most studies report consumers receive positive utility from recycling, all report that barriers, such as cost, public perception, and confusion, also affect recycling rates.

### 2.1 Recycling Trends in the U.S.

Recycling rates have steadily increased since recycling trends were first measured in the U.S. during the 1960s. In 2013, 87.2 million tons of materials were recycled, compared to 15 million tons in 1980 (EPA, 2012). Since 2005, waste generated that was recycled has remained between 31 and 34% (EPA, 2012).

The consumer packaging industry reported selling 4.2 trillion units of retail products in 2011 (Euromonitor International, 2013). Of this total, food packaging represented a staggering 43% of volume share. Rapid improvement of packaging technology has resulted in growing demand throughout the world for packaging related to produce and ready-made meals. Other trends in food packaging are individualized packaging resulting from on-the-go food products, smaller household sizes, and rising health awareness, (Mintel, 2014). As a result, the food-packaging sector is expected to have an annual growth rate of 3% between 2011 and 2016, thus increasing the need for research in the area of recycling.

### 2.2 Motives and Barriers to Recycling

Using a questionnaire from before and after a recycling scheme, Perrin and Barton (2001) found that the main reasons for recycling were convenience, concerns for future generations, the environment, and personal satisfaction. The study also found that the main reasons for not recycling were inconvenience, storage problems, and distance to recycling centers. Donohue

(2013) found that participants in a focus group concerning consumer packaging "feel better about their purchasing decisions if they believe they are more proactive about protecting the environment".

There are many studies that have focused on motives and barriers to collective recycling rates. One example used panel data of county-level recycling rates in Minnesota, (Sidique, Joshi & Lupi, 2009) to review several policies (e.g. mandatory recycling regulations and increasing recycling education expenditures) and their effects on recycling rates over a period of eight years. They found the biggest increase in recycling rates came from a variable pricing strategy, which is when households are charged more for larger trash cans, which decreases the relative cost of recycling bins. Through a study of recycling drop-off site participants, evidence was found that the distance to the drop-off site had a large impact on its usage (Sidique, Joshi, & Lupi, 2009). This suggests that the effort needed to recycle is a large determinate of consumers willingness to recycle. Their study concluded that higher income, older age, and larger household size were better predicting factors of usage of a recycling center than gender or marital status (Sidique, Joshi, & Lupi, 2009).

In a related study, researchers observed a natural experiment that distributed recycling bins to select participants and followed up with a questionnaire (Guagnano, Stern, & Dietz, 1995). As expected, households that were given a recycling bin were shown to increase their recycling rates more than the control households. They concluded that there could be several reasons for this change in behavior including: changed perception of social norms, increased convenience, or reduced cost of recycling. Gamba and Oskamp (1994) found that having specific knowledge about recycling was the strongest predictor of high recycling rates, followed by higher family income and higher number of people living in the household. All of these

studies suggest that consumers do receive positive utility from recycling, while there are barriers that need to be addressed before recycling rates can increase.

Halvorsen (2008) used an in-person survey in Norway to study the opportunity cost to of spent recycling. The study concluded that a consumer's increased opportunity cost of time recycling has a severe negative effect on household recycling efforts. They also found that although social norms including warm-glow and the 'Golden-rule' had a significant effect on recycling rates, monetary incentives had the largest effect.

### 2.3 Valuing Packaging and Recycling

There have been few previous studies that have researched consumer preference for packaging attributes. Rokka and Uusitalo (2008) used a choice experiment to find the relative importance of different packaging attributes in consumers' choices, including resealability, brand, and recyclability. Their results found that respondents receive 34% of their overall product utility from packaging. A portion of their respondents (31%) placed environmentally-friendly packaging as the most important factor in their purchasing decision. When determining factors that contributed to valuing packaging sustainability, they found no strong correlation to any particular demographic variable; rather valuing packaging sustainability correlated more closely to common interests and preferences (Rokka and Uusitalo, 2008).

Another study used a discrete choice model, with examples of shoes and batteries in six countries, to find consumers place a value on the social aspects of a product (Auger, Devinney, Louviere, & Burke, 2007). This study found that consumers from more developed countries were more influenced by the social attributes (e.g. use of child labor or recyclability) of a product. This study also showed that individuals who had previous knowledge about the social attributes of the products were more likely to choose more socially positive products in the experiment.

Many studies have examined household willingness to pay for curbside recycling. While some of these studies have been able to use revealed preference data to determine WTP for curbside recycling (for example, Aadland and Caplan, 2003; Guagnano, Stern, & Dietz, 1995), most of these studies have used choice experiments. Aadland and Caplan (2003) studied 1,000 households in Utah by phone interview, using a choice experiment. They had a direct comparison of revealed and stated preference for WTP for curbside recycling and found a mean WTP of $7.00 when asking in a hypothetical scenario, and $6.71/month when asking actual users of a recycling program. Karousakis and Birol (2008) used a choice experiment to estimate an average consumer WTP of £2.68/month to have one additional material accepted for recycling in London. More recently, Ferreria and Marques (2015) used a survey in Portugal to find a mean WTP for monthly recycling service of €1.35 and €3.16 depending on whether protest answers were included. Protest answers are when respondents refuse to give an amount they are willing to pay for a particular reason. They found that many of the protest answers had positive WTP for recycling, but respondents indicated that it was the government's duty to pay for waste management. These positive results on WTP for curbside recycling suggest that households may also display positive WTP for recyclable packaging materials.

# 3. Theory

This chapter introduces, explains, and evaluates the theories and instruments used in this study. These instruments are used to elicit consumer willingness to pay (WTP) for packaging recyclability and recycling attributes. WTP is the maximum amount that a given consumer is willing to pay for (and thus values) a good or service or a specific trait of a good or service. The advantage of estimating consumer WTP is that it provides pricing information that is meaningful for industry leaders and policymakers.

## 3.1 Willingness to Pay

Willingness to pay measurements can be determined using several different methods (Figure 2). The two most general categories are revealed and stated preference methods. Revealed preference methods assume utility maximizing behavior and infer people's preferences from analyzing how individuals make choices. Studies using revealed preference often analyze choices made by individuals, including natural and designed experiments. Stated preference methods use answers to questions and surveys to elicit what individuals would have chosen and infer preferences for a non-market good. Stated preference methods are usually criticized because they are prone to bias given their hypothetical nature and may not perfectly replicate real world circumstances. As a result, when data is available, revealed preferences are typically favored because they more accurately reflect an individual's true preferences. However, revealed preference techniques are not always available to a researcher as data might not be available. Stated preference techniques are usually more affordable and can be more easily utilized by the researcher to examine a specific research question.

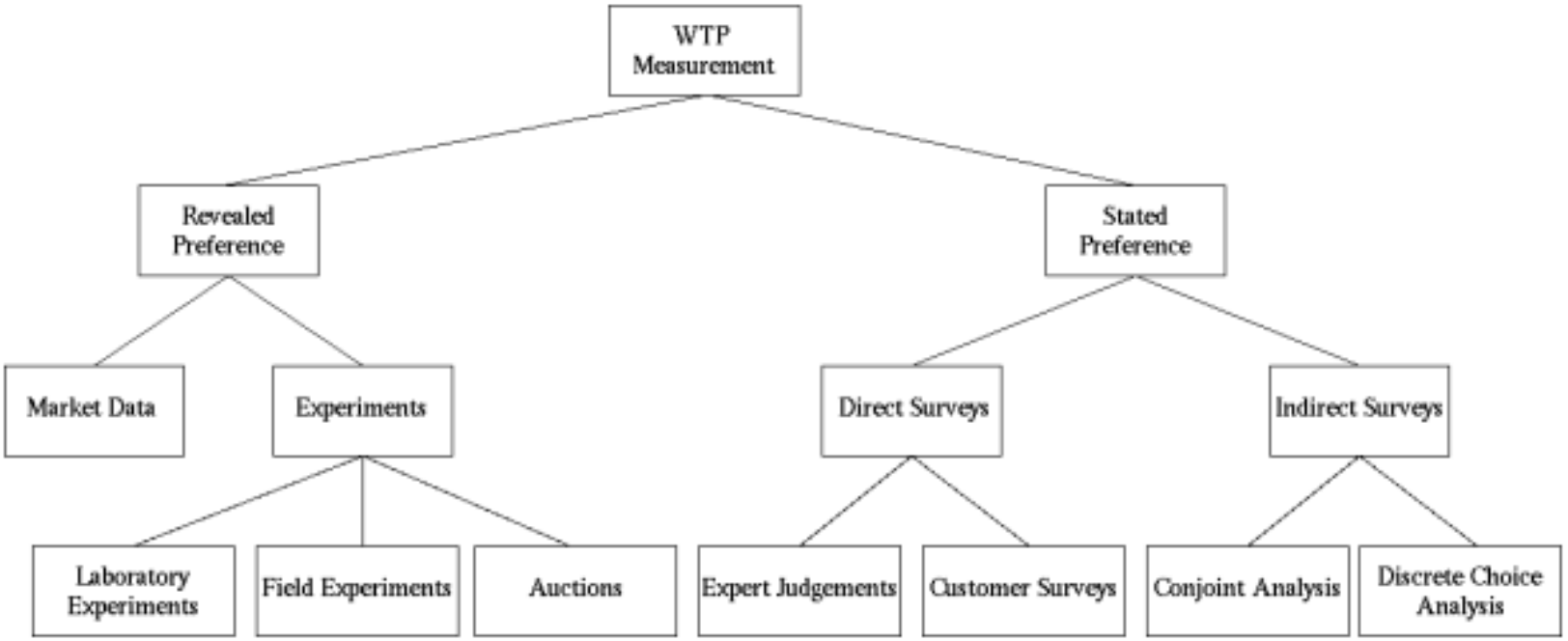


Figure 2: Classification framework for methods to measure willingness-to-pay
*Source: Breidert, C., Hahsler, M., & Reutterer, T., 2006*[1]

[1] Contingent Valuation Methods and choice experiments fall under discrete choice analysis

### 3.2 Contingent Valuation Methods

Contingent Valuation Method (CVM) is a stated-preference technique. This method was first developed to estimate the value of ecosystems and the flow of services that they provide. The method came under scrutiny after the 1989 Exxon Valdez oil spill, when a governmental panel, assembled by the National Oceanic and Atmospheric Administration, was charged with reviewing the validity of the method for natural resource damage assessments. The panel concluded that CVM could produce reliable estimates as long as a set of guidelines is followed to reduce bias (Arrow et., al. 1993). These guidelines include: having a strong, large, and representative sample, clear instructions, careful experimental design, and specificity when describing the good being valued (Kling, Phaneuf, and Zhao, 2012). Types of CVMs include direct surveys such as hypothetical referendums, where participants are shown a price for a particular environmental service and asked whether they would vote to have it provided.

Carson (2012), points out that the most important element to consider in a contingent valuation study is the "face validity" of the survey instrument, which refers to whether the instrument poses a credible proposal to respondents and provides all the necessary information in a clear format. More simply, the CV study has to be believable and target what the researcher wants to learn. Carson states that even though the CVM is not perfect, when done properly it can "provide a reliable basis for what the public is willing to trade off to obtain a non-market good" (2012). CVM has been used in a wide variety of studies ranging from a consumers' WTP for existence value of environmental services to WTP for governmental services (Carson, 2000). In this study, a stated preference CVM survey is used to measure different consumer responses to certain traits, including their WTP for packaging recyclability. We address the issue of face

validity of our instrument by collaborating with top executives from food companies when designing our survey.

### 3.3 Caveats associated with CVM

CVM has come under harsh review since the 1989 panel submitted their review of contingent valuation. CVM is prone to many biases, due to its hypothetical nature and lack of incentive compatibility, that must be addressed before experimental results can be accepted because of its hypothetical nature and lack of incentive compatibility. Two of the main issues that concern economists are hypothetical and social desirability bias.

#### 3.3.1 Hypothetical Bias

Hypothetical bias is the difference between what a person indicates that he/she would do versus what he/she would actually do in real life (Loomis, 2014). Hypothetical bias can be addressed through different survey designs. Possible *ex ante* survey tools include emphasizing the consequentiality of the respondent's choices, cheap talk, including an opt-out alternative, and urging honesty statements. Emphasizing the consequentiality of the respondent's choices has been shown to reduce bias by informing the respondent that his/her answer could ultimately affect their actual well being (Carson, Groves, and List, 2014).

Cheap talk reduces hypothetical bias by stating the problem of hypothetical bias explicitly to the participant. Often cheap talk is a script that states that in past surveys consumers often overstated their willingness to pay. Loomis' review of studies that used cheap talk, showed that while some studies were able to eliminate or reduce hypothetical bias, the effect was not universal (Loomis, 2014). Cummings and Taylor compared revealed and stated preference experiments in three separate studies and were able to eliminate hypothetical bias by using a cheap talk script (1999). However, they presented their cheap talk script in person and the script

was much larger than would be convenient for an online or telephone survey. In a more critical review of cheap talk, Aadland and Caplan (2006) compared actual and hypothetical willingness to pay for a curbside recycling program through a telephone survey. They found no reduction in hypothetical bias when using cheap talk. In fact, they found that with one of their longer, in-depth cheap talk scripts, hypothetical bias actually increased. They hypothesize that this increase was caused when because direction of the hypothetical bias was not stated in the cheap talk used. Another study by Aasland and Caplan (2003), found that using cheap talk in their study was more effective on people who would tend to state relatively high WTP. When estimating WTP for curbside recycling, they found using cheap talk resulted with a decrease of 59 cents (8.43%) on average WTP. Despite the potential issues involved with cheap talk methods, many studies that use CVM to elicit stated preference use cheap talk to address potential hypothetical bias (Olynk Tonsor and Wolf, 2010, Lusk, 2003, & Aadland and Caplan, 2003).

The urging honesty method differs from cheap talk by not explicitly stating that people overstate or understate their true choice in a hypothetical scenario. Rather, urging honesty is commonly seen as a statement in the beginning of a survey, in which the participant swears to answer questions truthfully. A study where students were asked to sign an oath of honesty found that signing the oath was able to eliminate hypothetical bias in the survey (Stevens, Tabatabaei, and Lass, 2013). Loomis (2014) suggests researcher use either the cheap talk *or* urging honesty methods because there have been cases where using cheap talk along with urging honesty has overcorrected for hypothetical bias. Moreover, including an opt-out or null alternative in discrete choice experiments avoids forcing the individual to choose between goods and skewing results (Hensher, 2010). This better replicates real world scenarios, since consumers often choose between similar goods or not purchasing the good at all.

### 3.3.2 Social Desirability Bias

Social desirability bias has also been shown to affect CVM results (Nederhof, 1985). Social desirability bias is the tendency of consumers to respond in a manner that they view as socially favorable or in a way that they feel is pleasing to the researcher. Given that recycling can be associated with environmental stewardship and social responsibility, it is conceivable that respondents may exhibit social desirability bias when answering questions about recycling. Indirect questioning is an unobtrusive technique used to mitigate social desirability bias. Rather than asking what the *respondent* would do, as in a typical survey, indirect questioning asks the respondent what they think *other people* would do. Studies have shown that indirect questioning has allowed researchers to reduce social desirability bias (Norwood & Lusk, 2011). Past research has shown that indirect questioning affects respondents' answers to variables that were subject to social influence, but does not affect respondents' answers to variables that bear no social stigma (Fisher, 1993). The main assumption behind this technique is that respondents receive positive utility from their own socially desirable behaviors, yet receive no utility from saying others conform to socially desirable behavior (Norwood & Lusk, 2011). Olynk, Tonsor, and Wolf (2010) used direct and indirect questioning in comparing consumer food choices and found that the indirect questioning yielded more accurate results.

## 3.4 Discrete Choice Experiments

Choice experiments (CE) are one type of stated preference tool used to elicit consumer preferences. CEs differ from other CVM instruments (experimental referendums, expert judges, conjoint analysis, and customer surveys) in that consumers are asked to choose from alternative bundles of attributes instead of ranking or rating them (Adamowicz, Boxall, Williams, and Louviere, 1998). In a typical CE, participants assess various levels of attributes across several

options, similar to what a consumer faces when making decisions in a real world scenario. In doing so, it elicits stated preferences for a good. By comparing other CVM instruments and a CE in valuing passive value for protection for a forested area in Canada, researchers found that the welfare values obtained had smaller variances (relative to their means) when using CE compared to other CVM instruments (Adamowicz, Boxall, Williams, and Louviere, 1998). A choice experiment design was chosen for this study since it provides the researcher ability to study how consumers weigh several different product attributes simultaneously.

### 3.5 Previous Studies Valuing Recycling With Choice Experiments

### 3.6 Approach

Building and expanding on previous research, our study uses two choice experiments to estimate consumer WTP for packaging recyclability. This survey also added a new element by including a time variable to measure consumers' willingness to expend effort in order to recycle. The time variable was transformed into a money-metric value in order to compare WTP for packaging recyclability and willingness to recycle packaging. Our survey uses cheap talk and indirect questioning in order to mitigate the hypothetical and social desirability bias. Two information treatments were used to add to the literature on the effects of information on consumer WTP for recyclable packaging.

## 4. Survey Method

### 4.1 Survey Overview

An online survey was used to understand consumer preferences for packaging recyclability as well as their current recycling habits.[2] There were 54 questions in the survey that determined consumer preference for packaging, grocery shopping habits, socio-economic demographics, and stances on environmental issues. The median time to completion was 19 minutes, with 90% of consumers completing the survey within 36 minutes. 2,000 surveys were completed between February 25 and March 3, 2015. The survey was developed in collaboration with sustainability and packaging executives from food companies in collaboration with Michigan State University's Center for Packaging Innovation and Sustainability. The survey was conducted online through a marketing research and survey company; Decipher Inc. Invitations to participate in the study were sent out from a consumer database maintained by Survey Sampling International (SSI). The survey was pre-tested and improved before conducting the actual survey. The pre-test resulted in some wording refinements and elimination of unclear questions. Additionally, to improve data quality, surveys completed in less than 10 were rejected to improve quality.

#### 4.1.1 Sampling plan

A marketing firm, Decipher Inc., sent out invitations to the survey to a large opt-in panel maintained by SSI. SSI sources participants through non-probabilistic methods including random digit dialing telephone recruitment, social media, and websites. SSI maintains a subpanel

[2] The implementation of this study was approved by Michigan State University's Internal Review Board.

of 400,000 members whose demographics roughly match that of the national census. SSI maintains this panel by eliminating duplicates and computer-generated responses (Survey Sampling International, 2015). Several studies in the past that used choice experiments have chosen respondents from SSI's online panel (Loureiro and Umberger, 2007; Olynk Tonsor and Wolf, 2010; Tonsor and Shupp, 2010).

A set of survey questions was specified in order to fill pre-set quotas to insure a varied group of responses were accepted and that they reflected the broader U.S. population. The targeted quotas included gender, age, income level, education level, and geographic region (within the United States). Results and demographics from this section are shown in Table 1 and discussed in Chapter 6. Responses were only accepted as part of the final analysis if they stated that they made the household food purchasing decisions. Our sample is representative of the 2010 census in terms of most demographic characteristics; however respondents reported slightly higher levels of education than the national average.

The ability to administer surveys through an online format has allowed researchers to reach a wider and more representative pool of respondents with minimal cost and time. Additionally, online surveys facilitate the addition of visual components to surveys, enhancing the respondent's ability to conceptualize the choice given to them (Savage & Waldman, 2008). Online surveys have been found to have higher response rates than mail surveys (Olsen, 2009). Moreover, Olsen (2009) found no significant difference in consumer willingness to pay from choice experiments administered online or through conventional mail.

### 4.2 Effects of Information

This survey used a between subject design to study the effects of information on consumer behavior. Two different information treatments were used to determine whether

additional information on the benefits of recycling increases consumer WTP and the amount of effort participants are willing to put into recycling. Since the percent of news and information that Americans receive from the television is increasing (Gallup, 2013), this study also compares video to written information presentation to assess the impacts of different information delivery strategies on consumer perceptions and behavior. This study used one infographic (Figure 3) that could be used on a packaging label and one short 30-second video that could be used as the basis for a commercial. The video utilized was the winning entry in a contest run by the EPA to promote household recycling (Figure 4 and Table 1). The infographic promoted general waste reduction, while the video provided specific examples on how recycling reduced energy consumption. It is important to keep in mind both the format in which the information is provided as well as the message of each information treatment. If neither information treatment is found to have a positive impact on a consumers recycling behavior, companies should find new avenues and messages to increase the value of recycling for their consumers.


Figure 3: Recycling Infographic
*Source: EPA, 2015*

Figure 4: Recycling Video Snapshot
*Source: EPA, 2015*

| |
|---|
| Recycling does not only save space in landfills, but also conserves energy and it is surprising how everyday items can really add up. Recycling one soup can saves enough energy to power a laptop for two hours. What if we recycled more? Recycling one 20-ounce plastic bottle can save enough energy to power an hour of TV. It's our planet, our stuff, and our choice. |

Table 1: Recycling Video Script
*Source: EPA, 2015*

**4.3 Survey Content**[3]

The survey had 4 distinct treatment groups, with 25% of the respondents randomly assigned to each group. The first group was the control group. The second group was the indirect questioning group. This group was asked what the average American would do in the experiments, but no indirect questioning was used for the non-experiment questions. The third group was shown the infographic in Figure 3 before the experiments. Finally, the fourth group was shown the video in Figure 4 with the script in Figure 5. Each treatment group had the same first two sections before the information treatments.

The first section of the survey focused on the respondents' household food and grocery shopping habits. Respondents were asked where and how often they shopped for groceries.

[3] A copy of the complete survey can be found in Appendix B

Certain food preferences were revealed in this section by asking what types of food characteristics they looked for while shopping such as on-the-go, GMO-free, vegetarian, packaging material, etc.

The second section of the survey focused on the respondents' packaging preferences, environmental attitudes, and recycling behaviors. Questions pertaining to incentives and barriers to recycling were asked alongside questions about their current habits. A series of matching questions were used to determine respondents' recognition and understanding of common recycling/packaging labels.

The third section of the survey was comprised of two choice experiments: one on WTP for packaging recyclability, another on barriers to recycling behavior. Preceding both choice experiments were explicit directions and an explanation of each of the attributes and options available to the respondent. Further explanation of the choice experiments will be presented in Chapter 6.

**4.4 Willingness to Pay Experiment**

For the choice experiment on willingness to pay for packaging recyclability, consumers were asked to base their decision on fruit juices and fruit juice drinks. We focused on this product because of the increased prevalence of juice drink consumption. According to a report recently published by Mintel (2014), 84% of American consumers reported purchasing fruit juice or juice drinks in the past six months. For those who bought juice in the past 6 months, 55% bought single-serve juice drinks; that number increases to 76% in the 18-24 age range. Furthermore, 32% of respondents reported purchasing more juice drinks than they did a year ago (Mintel, 2014).

For the first choice experiments, labeled choice sets were created taking into consideration the specifications of discrete choice models. Labeled choice sets shows an attribute consistently throughout all choice sets. In this choice experiment, packaging material was held consistent throughout all choice sets. In this choice experiment, respondents chose between one of four products or alongside an opt-out/no choice alternative.

- The first attribute, material, had four levels: glass, aluminum, plastic and carton. Since this was a labeled choice experiment these four materials were always presented as options in the choice sets, alongside an opt-out/no choice alternative.
- The second attribute was packaging recyclability: yes or no. Instructions were included on whether the specific material was recyclable in their hometown; the respondent was to base their decision on the option given.
- The third attribute was price. Prices were based on observed market prices. Price levels were: $0.75, $1.00, $2.00, and $3.00.

Choice sets were created by using a simultaneous orthogonal design in Ngene (ChoiceMetrics, 2011). With this design type, orthogonality holds within and across alternatives. The experimental design consisted of a total of 20 choice scenarios. The scenarios were blocked so that each respondent evaluated 5 choice sets. A sample choice set is provided in Table 2:

| Characteristics | Option 1 | Option 2 | Option 3 | Option 4 | Option 5 |
|---|---|---|---|---|---|
| Material | Plastic | Glass | Carton | Aluminum can | I would not purchase any of these products |
| Recyclable | Yes | Yes | Yes | No | |
| Price | $0.75 | $0.75 | $1.00 | $1.00 | |
| I would choose | ○ | ○ | ○ | ○ | ○ |

Table 2: Example choice set for packaging recyclability choice experiment

### 4.5 Willingness to Recycle Experiment

For the choice experiment focused on willingness to recycle, an on-the-go sandwich container was used as the product example. On-the-go packaging was used since it is one of the fastest growing trends in food and beverage packaging (Mintel, 2014). A recent study showed that on any given day, 49% of Americans eat at least one sandwich (Sebastian, Enns, Goldman, Hoy, & Moshfegh, 2014). Since sandwich consumption is so prevalent in the U.S., it was the basis for the second choice experiment.

This choice experiment uses an unlabeled design, with each option representing a hypothetical product to be recycled. For an unlabeled design, all attributes are varied in each choice set. Respondents were asked to choose between two products and an opt-out/no choice option if they would recycle neither option.

- The first attribute was packaging material: paperboard or plastic. These materials were chosen because they are common packaging materials used for sandwich containers.
- The second attribute was whether the package needs to be cleaned in order to be recycled: yes or no.
- The third attribute was how many different parts the packaging must be separated into in order to be recycled: 1 to 4. For example, a sandwich box might be mainly paperboard, but also has a film wrapper, etc. that need to be taken apart before recycling the main packaging.
- The fourth attribute was the time required to recycle the packaging with time options: 5, 10, 20, 30 or 60 seconds.

Choice sets were chosen by using a sequential orthogonal design in Ngene (ChoiceMetrics, 2011). With this design, orthogonality holds only within alternatives, reducing the number of choice sets in the design. The experimental design consisted of a total of 20 choice scenarios. The scenarios were blocked so that each respondent evaluated 5 choice sets. A sample choice set is provided in Table 3.

| Characteristics | Option 1 | Option 2 | Option 3 |
|---|---|---|---|
| **Type of material** | Paper/boxboard | Plastic | I would not recycle either of these |
| **Cleaning required for recycling** | No | Yes | |
| **Number of Packaging Parts** | 2 | 4 | |
| **Time required to recycle** | 30 sec | 5 sec | |
| **I would recycle** | ○ | ○ | ○ |

Table 3: Example choice set for willingness to recycling choice experiment

# 5. Research Method

## 5.1 Theoretical Framework

The framework of this study follows Lancaster's Theory of Demand and Consumer Utility from his 1966 paper "A New Approach to Consumer Theory". Before this paper, economists studied utility derived from the entire good. Lancaster argued that consumers do not receive utility from consuming the aggregate good; rather consumers receive utility from its different attributes or characteristics. Lancaster's (1966) new consumer theory has three main assumptions:

1. The good itself does not give utility to the consumer; it possesses attributes, and these attributes provide the consumer with utility
2. In general, a good possesses many attributes, and these attributes can be shared by many goodsa
3. Goods in combination may possess attributes different from those pertaining to the goods separately.

For example, in this study, consumers receive utility from all aspects of consuming fruit juice: the packaging, the price, the flavor, the color, etc.

Choice experiments work by varying the levels of different attributes and asking respondents to choose between them, contrasting with other CVM methods that directly ask WTP. Random utility theory is used in this study, which has been widely applied to studies that value consumer preference for products with multiple attributes (Manski, 1977). Random utility theory assumes that individuals seek to maximize their expected utility, given the budget and potential choices. Also, the individual's utility is considered to be a random variable because the researcher has incomplete information (Manski, 1977).

**5.2 Empirical Model**

An individual will evaluate each alternative as represented by $U_j : j = 1..J$ alternatives. An individual decision maker's rule is that they will compare $U_1, U_2, ....U_J$ and choose the alternative which proved them with maximum utility.

Individual *i* will choose product *j* from *J* alternatives in situation *t* if and only if:

(1) $U_{ijt} > U_{ikt}, \forall j \neq k \forall k \in J$

Specifically, utility $U_{ijt}$ is a combination of both a deterministic and stochastic term:

(2) $U_{ijt} = V_{ijt} + \varepsilon_{ijt}$

The utilities associated with each alternative are not directly observable in the choice experiment because they include an unobserved component. Therefore, the probability of selecting alternative *j* is:

(3) $P(j) = P(v_{ij} + \varepsilon_j \geq v_k + \varepsilon_k), j \neq k \forall j \in J$

If we assume that the coefficients vary over decision makers in the population with density f(θ) then the resulting probability of individual *i* choosing alternative *j* is:

(4) $P_{ijt} = \int \frac{e^{V_{ijt}}}{\sum_j e^{V_{ijt}}} f(\theta) d\theta$

Although there are several model specification that can be used with this theory to estimate utility, e.g., conditional or multinomial, the Random Parameters Logit (RPL) model was chosen. RPL is more flexible than the other models since it accounts for heterogeneity among individuals (McFadden and Train, 2000). Since RPL allows for random taste variation within the set of individuals, RPL is free of the independence of irrelevant alternatives assumption and allows correlation in unobserved factors over time (Train, 2003). In this model, indirect utility is assumed to be linear and can be written as

(5) $V_{ijt} = \beta'_i X_{ijt} + \varepsilon_{ijt}$

where $X_{ijt}$ is a vector of attributes for the $j^{th}$ alternative. $\beta_i$ is a vector of individual-specific taste parameters and $\varepsilon_{ijt}$ is a stochastic component of utility that is independently and identically distributed across individuals and alternative choices. This stochastic component of utility captures unobserved variations in tastes and errors in consumer perceptions and optimization. $\varepsilon_{ijt}$ has a type-I extreme value distribution, also known as the Gumbel distribution.

In order to operationalize the RPL model, the researcher must specify the distribution of the random parameters, this allows the researcher to estimate the distribution of preference parameters for each individual. The traditional approach has been to specify the distribution of non-price coefficients as normal, holding the price coefficient constant. Specifying the distribution of the price parameter as normal would be problematic since a normal distribution would allow positive values for the price parameter. This is illogical since economic theory predicts that individuals obtain negative utility from an increase in price. Also, a normally distributed price parameter could result in deriving distributions of WTP measures with infinite variances. Because of these reasons most researchers assume a fixed price coefficient.

In line with the literature, distribution of the random parameters is normally distributed for all variables, except for price, which is fixed. Specifying utility as separable in price, $p$, and as a vector of non-price attributes $X_{ijt}$, we can rewrite equation 2 as:

(6) $U_{ijt} = -\alpha p_{ijt} + \beta' X_{ijt} + \varepsilon_{ijt}$

Following model estimation, WTP for each attribute $X$ is derived shown in equation 7 .[4]

[4] To eliminate the potential confounding effects between the intercept and certain attribute levels, the data was effect coded, which means the coefficient is just in comparison to the opt-out option. With effects coding, the estimated WTP have to be multiplied by 2 to generate the appropriate marginal WTP measures.

(7) $WTP_X = -\frac{\beta}{\alpha}$

Assuming a fixed price coefficient is analogous to assuming that preferences over prices are homogeneous in the population, and implies that the standard deviation of unobserved utility or the scale parameters is the same for all observations. Louviere (2003) convincingly argues that the scale parameter can, and indeed often does, vary randomly over observations, and ignoring this variation can result in erroneous conclusions. In the context of product choice modeling, if the price coefficient is constrained to be fixed, when in fact scale varies over observations, then the variation in scale will be incorrectly attributed to variation in WTP for product characteristics. A solution is this problem is to parameterize the model such that the parameters represent the marginal WTP for each attribute rather than the utility coefficient of each attribute. The appeal of this approach is that it allows the researcher to specify and estimate the distributions of WTP directly, rather than deriving them indirectly from distributions of coefficients in the utility function as in equation 5 (Scarpa, Thiene, and Train, 2008). Following Train and Weeks (2005), we divide utility in Equation 6, by a scale parameter $k_{ijt}$ to reparametrize the model resulting in equation 8:

(8) $V_{ijt} = -\lambda_{ijt} p_{ijt} + (\lambda_i \omega_i)' X_{ijt}$

Where new coefficient $\lambda$ is defined as $\lambda_{ijt} = (\alpha_{ijt} / k_{ijt})$ and $\omega_{ijt} = (\beta_{ijt} / \alpha_{ijt})$ is a vector of WTP for the product attributes that is independent of scale (Train and Weeks, 2005).

The attributes used in the estimation of the model parameters for each choice experiment are given in Tables 4 and 5.

Table 4: Packaging materials choice experiment parameters

| | |
|---|---|
| **Material** | Glass, Plastic, Aluminum, and Carton |
| **Packaging Recyclability** | Yes, indicates the packaging is recyclable, whether or not that material is actually recyclable in your community |
| **Price** | Price for the fruit juice drink |

Table 5: Barriers to recycling choice experiment parameters

| | |
|---|---|
| **Type of Material** | Paperboard in comparison to plastic. |
| **Cleaning** | Whether the packaging was required to be cleaned in order to be recyclable |
| **Values of Time**[5] | Time required to recycle the packaging transformed into opportunity cost of time |
| **Number of Packaging Parts** | How many parts the packaging must be separated into in order to be recycled: 1 to 4. |

[5] Consumer opportunity cost of time was calculated by using their self-reported household annual income. The wage imputation was calculated following previous literature where annual income is divided by 2000 hours of work time (50 weeks at 40 hours per week). This survey did not ask respondents their exact income, rather it provided 8 range options that could be selected. The choices were less than $20K, $20K-40K, $40K-$60K, $60K-$80K, $80K-$100K, $100K-$150K, $150K-$200K, and more than 200K. To convert the ranges into a continuous variable, we used the midpoint range for the first 7 choices. Respondents reporting an income over 200K were assigned an income of $400K. The final computation of the opportunity cost of a second was taken by taking the hourly wage rate and dividing it by 3600 (60 minutes in an hour, 60 seconds in a minute).

## 6. Data Analysis

This chapter presents and interprets the results of the econometric estimation of consumer incentives for recycling. First, background data is presented. The choice experiments are analyzed separately, then the implications of the choice experiments are reviewed.

Table 6: Descriptive statistics of the observed sample population in percentage

| | Survey | 2010 Census |
|---|---|---|
| Age | | |
| 18 to 24 years | 11 | 13 |
| 25 to 44 years | 37 | 35 |
| 45 to 64 years | 36 | 35 |
| 65 to 13 years | 16 | 17 |
| Gender | | |
| Male | 48 | 49 |
| Female | 52 | 51 |
| Education | | |
| Did not graduate from high school | 4 | 12 |
| Graduated from high school | 30 | 31 |
| Attended College, no degree earned | 28 | 26 |
| Attended college, degree earned | 34 | 19 |
| Graduate/Advanced Degree | 4 | 11 |
| Household Income | | |
| <$20,000 | 20 | 20 |
| $20,000-$59,999 | 41 | 40 |
| $60,000-$99,999 | 25 | 20 |
| $100,000-$200,000 | 12 | 17 |
| >$200,000 | 2 | 3 |
| Region of the U.S. | | |
| South | 35 | 37 |
| West | 24 | 23 |
| Northeast | 19 | 18 |
| Midwest | 22 | 22 |
| Urban Rural Continuum | | |
| 1) Counties of 1 million or more | 54 | 55 |
| 2) 250,000 to 1 million population | 25 | 21 |
| 3) metro area < 250,000 | 8 | 9 |
| 4) population > 20,000 adjacent to metro | 4 | 4 |
| 5) population > 20,000 not adjacent to metro | 2 | 2 |
| 6) 2,500 < population <19,999 adjacent to metro | 4 | 5 |
| 7) 2,500 < population <19,999 not adjacent to metro | 2 | 3 |
| 8) population< 2,500 adjacent to metro | 1 | 1 |
| 9) population< 2,500 not adjacent to metro | 1 | 1 |

Source: Survey data.
Notes: Age percent is calculated for population above 18, Education percentage for 2010 census is calculated for population older than 25

A comparison from the observed demographics from our survey with the equivalent 2010 census data shows our survey resembles the demographic makeup of the U.S. population. In our survey we have slightly oversampled respondents in the middle of the distribution of education. Statistics for select recycling habits, recycling rates and incentives to recycle can be found in Appendix A.

### 6.1 Willingness to Pay for Recyclability Choice Experiment

The choice experiment estimating WTP for packaging recyclability was first estimated using the random parameters logit model in preference-space (Appendix C). All of the estimated coefficients in every treatment were statistically significant at the 10% level. As expected, the coefficients were negative for price and positive for recyclability and material, suggesting respondents received positive utility from recyclability and packaging materials. Since the estimated coefficients are measured in utils (units of utility), a non-cardinal measure, it is more convenient to transform them and analyze them as WTP estimates (Table 7). Estimated coefficients for every treatment in WTP-space can be found in Appendix C.

Confidence intervals for the random parameters logit model estimated in preference space were derived using the Krinsky-Robb method.[6]. Because WTP measures in preference space are non-linear functions of estimated parameters, common methods for determining a confidence interval are not appropriate since they result in symmetric confidence intervals. Confidence intervals were estimated with 1000 draws with the Krinsky-Robb method.

[6] The Krinsky-Robb approach is used to simulate an asymptotic distribution of the WTP by randomly drawing from a multivariate normal distribution, constructed by the combination of the coefficient estimated and the associated variance-covariance matrix from the RPL model.

From the results in Table 7, we can see positive average WTP for packaging recyclability for a 12-ounce juice drink for all treatment groups. In comparison to the other treatment groups, the indirect questioning treatment group reported significantly lower WTP for packaging recyclability at the 1% level. If the sample were a true representative sample of the U.S. consumer and there were no social desirability bias, we would expect to see the mean WTP for the control group to match that of the indirect questioning group. Since the mean of the indirect questioning group is statistically significantly lower than that of the control group it means one of two possibilities or a combination of both: the sample is not representative of the U.S. population and we are over-sampling consumers with higher WTP for recycling, and/or respondents in this survey are biased and report higher WTP than for the average American. Likely, our sample's true mean WTP for recyclable packaging lies in between that of the indirect questioning and the control group's mean.

A t-test was performed and revealed significant increase in WTP for the video treatment group at the 5% level. Although the variance for each average WTP is large, mean WTP for the video treatment is 31 cents more than that of the control group. Since this is an increase of 24% from the control group estimation, this result represents a considerable increase. The results of the t-test showed that in comparison to the control group, the information treatment did not have a statistically significant impact on WTP for packaging recyclability. The difference between these two information treatments indicates that the channel in which media is presented does have an impact on consumer WTP for packaging recyclability.

Table 7: WTP estimated derived from model estimation in preference space and WTP-space

| | Preference Space | | WTP-space | |
|---|---|---|---|---|
| | Mean | 95% CI | Mean | 95% CI |
| Control | | | | |
| *Packaging Recyclability* | 1.46 | [1.27, 1.65] | 1.31 | [1.14, 1.48] |
| *Plastic Packaging* | 2.19 | [2.02, 2.37] | 2.10 | [1.96, 2.24] |
| *Glass Packaging* | 2.03 | [1.85, 2.21] | 2.10 | [1.94, 2.25] |
| *Carton Packaging* | 1.79 | [1.61, 1.96] | 1.79 | [1.64, 1.94] |
| *Aluminum Packaging* | 1.46 | [1.28, 1.65] | 1.52 | [1.67, 1.37] |
| Indirect Questioning | | | | |
| *Packaging Recyclability* | 0.54 | [0.40, 0.67] | 0.49 | [0.40, 0.57] |
| *Plastic Packaging* | 2.8 | [2.61, 2.99] | 2.86 | [2.64, 3.09] |
| *Glass Packaging* | 2.2 | [2.01, 2.39] | 2.29 | [2.07, 2.51] |
| *Carton Packaging* | 2.12 | [1.93, 2.31] | 2.16 | [1.93, 2.39] |
| *Aluminum Packaging* | 2.32 | [2.13, 2.53] | 2.39 | [2.17, 2.60] |
| Infographic Treatment | | | | |
| *Packaging Recyclability* | 1.51 | [1.29, 1.74] | 1.41 | [1.26, 1.56] |
| *Plastic Packaging* | 2.05 | [1.88, 2.23] | 1.93 | [1.83, 2.04] |
| *Glass Packaging* | 1.89 | [1.72, 2.07] | 1.74 | [1.62, 1.86] |
| *Carton Packaging* | 1.72 | [1.55, 1.90] | 1.63 | [1.52, 1.75] |
| *Aluminum Packaging* | 1.49 | [1.31, 1.68] | 1.45 | [1.32, 1.57] |
| Video Treatment | | | | |
| *Packaging Recyclability* | 1.67 | [1.44, 1.90] | 1.62 | [1.45, 1.78] |
| *Plastic Packaging* | 2.13 | [1.94, 2.33] | 2.05 | [1.92, 2.18] |
| *Glass Packaging* | 1.98 | [1.79, 2.16] | 2.03 | [1.90, 2.17] |
| *Carton Packaging* | 1.71 | [1.51, 1.92] | 1.64 | [1.49, 1.78] |
| *Aluminum Packaging* | 2.32 | [2.13, 2.53] | 1.59 | [1.46, 1.73] |

*WTP estimates are reported in $ per single serve juice drink
**Model fit statistics can be found in Appendix C

From Table 7 we can see that the mean for WTP estimated in the two models fall within each other's 95% confidence interval. However, from the density graph in Figure 5, we can see that estimates in WTP-space tend to be more normally distributed and report less extreme values than estimates in preference space. This is in line with past research (Scarpa, Thiene, & Train, 2008) that has found that estimating respondents values in WTP-space addresses the "fat tail" problem of reporting many extreme values, which takes place when estimating WTP in preference space. In recent years estimating willingness to pay in WTP-space has grown in

popularity because it reduces extreme values. Therefore, estimates obtained from estimation in WTP-space will be used to analyze the data.

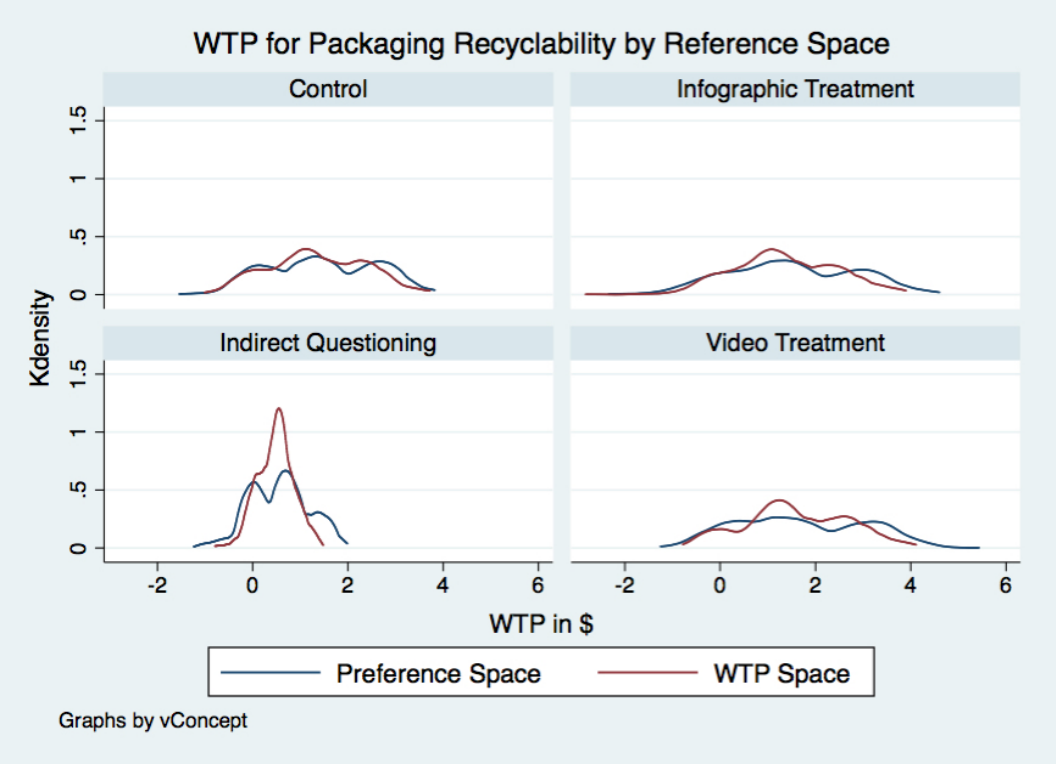


Figure 5: Density graph of estimated WTP for packaging recyclability in preference space and WTP-space

Understanding determinants of WTP for packaging recyclability is important for packaging companies in order to promote recyclability in the U.S. The random parameters logit model allows researchers to estimate individual WTP conditional on average estimated WTP and the specified parameter distribution. Estimated individual WTP for packaging recyclability were estimated by taking the estimated mean WTP and parameter distribution. We regress consumer WTP for packaging recyclability on basic demographics including age, education, etc. with results shown in Table 8.[7] Beyond the typical demographic variables, the following recycling specific variables were included: "Price sensitive" denotes that the respondent stated that price

[7] Individual WTP for packaging recyclability regressions by treatment group can be found in Appendix G

was an important barrier to recycling (on a scale from least important (1) to most important (5)). "Time sensitive" denotes that the respondent stated time was an important barrier to recycling (on a scale from least important (1) to most important (5)). For the "Energy reasons" variable, respondents reported that their main reasons for recycling was because recycling materials requires less energy than creating new materials. "Recycling Confusion" is a dummy variable that is equal to 1 if respondents did not know if there was a recycling program in their community. "Environmental Warm-glow" denotes respondents attitudes to the statement "I feel good when I take steps to help the environment" from disagree completely (1) to agree completely (7). "Bottle Return States" is a dummy variable for states with a current refundable deposit system on certain containers. Dummy variables for the indirect questioning, infographic, and video treatment were included in this regression. Distributions for these variables can be found in Appendix A.

Table 8: Determinants of estimated individual WTP for packaging recyclability: OLS robust regression

| | |
|---|---|
| Indirect Questioning | -0.874*** |
| | (0.058) |
| Infographic | -0.004 |
| | (0.058) |
| Video | 0.263*** |
| | (0.058) |
| Female | 0.044 |
| | (0.042) |
| Age | -0.018** |
| | (0.008) |
| Age Squared | 1.68E-04** |
| | (0.000) |
| Education | 0.010 |
| | (0.012) |
| White | 0.027 |
| | (0.053) |
| Income | 0.008 |
| | (0.012) |
| Urban Continuum | 0.019 |
| | (0.013) |
| Time Sensitive | -0.059*** |
| | (0.021) |
| Price Sensitive | -0.013 |
| | (0.021) |
| Environmental Warm-glow | 0.098*** |
| | (0.018) |
| Bottle Return States | -0.028 |
| | (0.046) |
| Water Reasons | 0.073** |
| | (0.029) |
| Energy Reasons | -0.003 |
| | (0.029) |
| Democratic Voters | 0.025 |
| | (0.049) |
| Republican Voters | -0.095* |
| | (0.053) |
| Constant | 0.985*** |
| | (0.203) |
| Observations | 2,001 |
| R-squared | 0.225 |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.10

The results in Table 8 are consistent with past research suggesting socio-economic demographics are not highly correlated with utility derived from recycling (Rokka and Uusitalo,

2008). Willingness to pay for packaging recyclability is correlated more with motives than socio-economic demographics. WTP is correlated with age with WTP for packaging minimizing at age 59. Respondents who reported warm-glow from participating in environmentally friendly activities were willing to pay more for recyclable packaging than those who did not report environmental warm-glow. From a list of motives for recycling, respondents who recycle to reduce energy the water pollution consumed showed a higher WTP for recyclable packaging. Republican voters also reported a slightly significant decrease in WTP for packaging recyclability in comparison to independents.

A fraction of respondents displayed a negative willingness to pay for packaging recyclability. A nonparametric test proposed by Poe et al. (2005)[8] was used to compare the two groups. The Poe test results in a p-value that estimates the likelihood that the null hypothesis is false. The null hypothesis in this case is that the demographics of the lowest WTP are equal to that of the highest WTP. Those in the low WTP group consist of respondents with estimated WTP of less than 10 cents, with all other responses in the high/average group.

Table 9: Comparing negative and positive WTP for packaging recyclability

| | Highest 85% WTP (n=1708) | | Lowest 15% WTP (n=293) | | P-value |
|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | |
| Female (%) | 0.53 | 0.50 | 0.48 | 0.50 | 0.20 |
| Age | 45.77 | 16.48 | 44.68 | 15.79 | 0.29 |
| Education (scale) | 3.98 | 1.73 | 3.72 | 1.67 | 0.01*** |
| Income (scale) | 3.17 | 1.76 | 3.08 | 1.86 | 0.44 |
| White (%) | 0.77 | 0.42 | 0.76 | 0.43 | 0.98 |
| Democrats (%) | 0.35 | 0.48 | 0.31 | 0.46 | 0.16 |
| Republicans (%) | 0.24 | 0.43 | 0.29 | 0.46 | 0.06* |

Note: SD means standard deviation *** p<0.01, ** p<0.05, * p<0.10

From the results in Table 9, it can be seen that the most significant correlation is respondents with the lowest estimated WTP were more likely to report lower levels of education. Additionally, respondents who self-reported as Republican were more likely to be in the lowest

[8] This test will be referred to as a Poe-test from now on.

WTP group, at the 10% statistically significant level.

Table 10: WTP for recyclability by material and treatment

| | Control | | Indirect Questioning | | Infographic Treatment | | Video | |
|---|---|---|---|---|---|---|---|---|
| | Mean | 95% CI | Mean | 95% CI | Mean | 95% CI | Mean | 95% CI |
| *Plastic* | 1.54 | [1.30, 1.80] | 0.60 | [0.46, 0.72] | 1.24 | [1.02, 1.44] | 1.64 | [1.42, 1.86] |
| *Glass* | 1.12 | [0.94, 1.32] | 0.18 | [0.02, 0.32] | 0.80 | [0.60, 0.98] | 1.24 | [1.08, 1.42] |
| *Carton* | 1.10 | [0.88, 1.34] | 0.22 | [0.10, 0.34] | 0.98 | [0.76, 1.18] | 1.06 | [0.82, 1.32] |
| *Aluminum* | 1.34 | [1.08, 1.56] | 0.60 | [0.44, 0.72] | 1.10 | [0.96, 1.30] | 1.28 | [1.06, 1.48] |
| N | 2500 | | 2500 | | 2500 | | 2505 | |
| Log-likelihood | -2992 | | -2940 | | -3132 | | -3153 | |
| Pseudo $R^2$ | 0.256 | | 0.269 | | 0.221 | | 0.218 | |
| AIC | 2.41 | | 2.37 | | 2.52 | | 2.53 | |

Note: Number of parameters estimated is 18.

Breaking down WTP for recyclability by material in Table 10 enables us to see that the respondents did report a slight difference for WTP by treatment group. WTP for recyclability for plastic was significantly higher than for glass and carton at the 10% for all treatment groups. This contrasts to consumer WTP for material where respondents reported a significant difference in WTP for materials.[9] A possible explanation for this is that consumers are more concerned about plastic packaging ending up in a landfill rather than carton or glass. Consumers may believe that plastic is the most important materials to recycle. Tables for OLS regressions on WTP for packaging material can be found in Appendix D.

### 6.2 Barriers to Recycling Choice Experiment

The choice experiment measuring consumer's willingness to recycle was estimated using random parameters logit. Tables showing consumer utility in random parameters logit in preference space can be found in Appendix E. Since consumer utility was measured in seconds, not dollars, consumer opportunity cost of time was calculated. Estimation results for consumer opportunity cost to overcome barriers are shown in Table 11.

[9] T-test results comparing WTP for packaging material within treatment group can be found in Appendix F

Willingness to accept (WTA) is the minimum amount of money that a person is willing to accept to give up something or to put up with something negative, such as cleaning. The standard assumptions of economic theory imply that when income effects are small, the gap between WTP and WTA should be negligible. Since measurements in this choice experiment are very small, the negative amount of WTP should be equal to WTA. This choice experiment values burdens, where expected WTP should be negative, therefore results will be presented in a willingness to accept format.

The interpretation of the WTA estimates for paper/boxboard is that consumers are willing to accept $X more to recycle paper/boxboard packaging relative to plastic packaging. The cleaning WTA estimates can be interpreted as consumers are willing to accept $X to clean a single unit of packaging in order to recycle it. WTA for parts can be interpreted as consumers are willing to accept $X per part in order to recycle a single unit of packaging.

Table 11: WTA to Recycle Estimation in WTP-space

| | Control | Indirect Questioning | Infographic | Video |
|---|---|---|---|---|
| | Mean [95% CI] | Mean [95% CI] | Mean [95% CI] | Mean [95% CI] |
| *Paper/boxboard* | 0.00 [-0.03, 0.03] | 0.00 [-0.01, 0.01] | -0.02 [-0.04, 0.01] | -0.01 [-0.01, 0.03] |
| *Cleaning* | 0.06 [0.02, 0.09]** | 0.08 [0.05, 0.10]** | 0.08 [0.05, 0.12]** | 0.07 [0.04, 0.10]** |
| *Parts* | 0.01 [-0.01, 0.02] | 0.01 [0.00, 0.02]** | 0.00 [-0.02, 0.01] | 0.00 [-0.01, 0.02] |
| N | 2500 | 2500 | 2500 | 2505 |
| Log-likelihood | -1971 | -1953 | -1968 | -1986 |
| Pseudo $R^2$ | 0.28 | 0.29 | 0.28 | 0.278 |
| AIC | 3962 | 3926 | 3957 | 3993 |

Note: Number of parameters is 10. ** $p<0.05$

The WTA estimates for the material parameter are not significant in any of the treatment groups (Table 11). This suggests that consumers do not have a preference for paper/boxboard packaging over plastic packaging when deciding to recycle. The WTA estimate for parts is negative and significant for the indirect questioning group, but not for the other treatment groups. This can be interpreted as respondents do not report a WTA for the number of parts they have to separate, but think that the average American would have a positive WTA for each part they had

to separate. Respondents either reported socially biased answers in the control and information treatment groups, or our sample is less likely to view an additional part to recycle as effort compared to the average American.

Results presented in Table 11 show that average WTA to clean in order to recycle is positive and significant for all treatment groups (distributions from each treatment group can be seen in Figure 6). This is intuitive, since cleaning packaging takes both time and effort, respondents should report significant WTA to clean. Mean WTA to clean is approximately 7 cents as measured in opportunity cost of time. Differences between estimated WTA for the different treatment groups are not statistically significant. Although respondents in the indirect questioning group did not have a statistically significant different WTA to clean, respondents in the indirect questioning group were more likely to choose to opt-out/not recycle the packaging. Willingness to accept to clean will be used as the basis for effort since it is an interaction between consumer opportunity cost of time and effort needed to recycle.

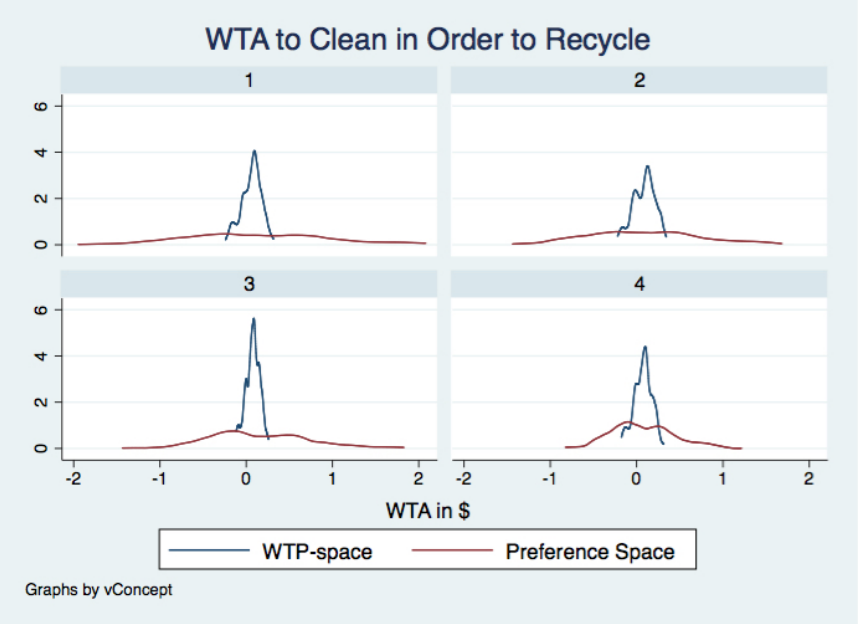


Figure 6: Density graph of estimated WTA to clean in order to recycle in preference space and WTP-space

OLS robust regressions were used to correlate individual WTA to clean in order to recycle with certain demographics (Table 12). Results show that the coefficients for the indirect questioning, infographic, and video treatment groups were all statistically significant and positive. Since the indirect questioning group is correlated with higher WTA, this could be interpreted as consumers in the control group reporting socially biased answers. Since we are seeing counter-intuitive signs for the two information treatments, it may be the case that the information treatments reminded the consumers of the effort required to recycle.

Both Democratic and Republican voters reported lower WTA values in comparison to independents. Also, consumers who recycle for energy reasons view cleaning as less of a barrier than those who recycle for other reasons. Consumers who lived in states with bottle-return laws did report a lower WTA to clean than those who live in states without bottle-return laws. Since these states normally report higher recycling rates on average, it might be more of a social norm for these consumers to put in the effort in order to recycle.

Table 12: Determinates of estimated individual WTA to clean in order to recycle: OLS robust regression

| Variables | Regression Coefficients |
|---|---|
| Indirect Questioning | 0.0152** |
| | (0.007) |
| Infographic | 0.024*** |
| | (0.007) |
| Video | 0.013* |
| | (0.007) |
| Female | 0.005 |
| | (0.005) |
| Age | 0.000 |
| | (0.000) |
| Age Squared | -0.001 |
| | (0.001) |
| Education | 0.002* |
| | (0.001) |
| White | 0.023*** |
| | (0.006) |
| Income | 0.000 |
| | (0.001) |
| Urban Continuum | -0.001 |
| | (0.001) |
| Time Sensitive | 0.002 |
| | (0.002) |
| Price Sensitive | -0.004 |
| | (0.002) |
| Warm-glow | 0.001 |
| | (0.002) |
| Bottle Return States | -0.012** |
| | (0.005) |
| Water Reasons | 0.003 |
| | (0.003) |
| Energy Reasons | -0.001*** |
| | (0.003) |
| Democratic Voters | -0.016*** |
| | (0.006) |
| Republican Voters | -0.014** |
| | (0.006) |
| WTP Packaging Recyclability | -0.007*** |
| | (.006) |
| Constant | 0.101*** |
| | (0.024) |
| Observations | 2,001 |
| R-squared | 0.037 |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Although the WTP for packaging recyclability and WTA to clean to recycle cannot be compared directly since they use two different products and focus on two different parts of recycling, WTP for packaging recyclability was still used as an independent variable in the WTP to clean regression. WTP for packaging recyclability is correlated with a lower WTA to clean in order to recycle. For every $1 increase in WTP for packaging recyclability, there is an expected .07 cent decrease in WTA to clean in order to recycle. Since average WTA to clean is 6 cents this represents a 12% decrease in WTA to clean for each additional dollar WTP to packaging recyclability.[10]

[10] These results were robust across several regression specifications. Regression results from alternative estimations can be found in the appendix.

## 7. Discussion & Conclusion

In this study, we used a nationally representative survey that includes two choice experiments to estimate U.S. consumer WTP for packaging recyclability and willingness to recycle. These findings can help the packaging industry to adjust their recyclable packaging and their messaging for their target consumer.

### 7.1 Summary of Key Results

Average estimated WTP for packaging recyclability is positive for all materials, however, it is the highest for plastic, followed by aluminum can, glass, and then carton. Since consumers are willing to pay the most for plastic packaging recyclability, consumers may view plastic as more detrimental if it is thrown away. Although, aluminum recyclability was only significantly higher at the 10% level, it should be noted that aluminum packaging was valued the least, showing a difference between how consumers value packaging materials and their recyclability.

For WTP for packaging recyclability, Republican voters report lower WTP than non-Republicans. Consumers who reported recycling to decrease water pollution were likely to report higher WTP for packaging recyclability. Since recycling does not directly contribute to decreasing water pollution, packaging companies may choose to either exploit this misconception or clarify to consumers how recycling benefits the environment. It is important to point out that consumers who live in bottle state laws did not report an increase in WTP for packaging recyclability. This may result from consumers being accustomed to prices for beverages in their states and not noticing the increase in price due to the deposit laws.

Mean willingness to accept to clean did not change by treatment group. However, when holding demographics constant in the individual WTA to clean regressions, the indirect treatment group did show a significant decrease in WTA. This suggests that consumers in the

control group did report some type of bias. The decrease in WTA for the video and infographic groups could be a result of the information treatments being a sort of a reminder of the effort of recycling.

Additionally, consumers with a higher WTP for packaging recyclability also report that cleaning is less of a barrier to recycling. White consumers reported higher willingness to accept to clean packaging for themselves, but not for the average American in comparison to non-white consumers. Consumers who recycle for energy reasons reported a lower willingness to accept to clean over consumers who recycle for other reasons. Since reducing total energy consumed is one of the main reasons for recycling, consumers who recycle for energy reasons maybe more informed on the topic, therefore willing to put in more effort in order to recycle.

### 7.2 Limitations

As with any stated preference experiment there are limitations to this study. Since preferences are stated and not revealed, there exists the potential for hypothetical bias with this survey. It can be assumed that the cheap talk before the experiments reduced some of the hypothetical bias, but did not eliminate all of the bias. There also exists an issue not addressed in this study called attribute non-attendance, which is when consumers ignore one or more attributes when deciding between choices, often when the number of attributes is large. Future research should be done to determine which packaging attributes consumers consider when purchasing a product, as decision making can affect choice model estimates.

### 7.3 Implications

As the quantity of packing sold in the U.S. increases, waste from the packaging has also increased. Since environmental awareness has risen in the U.S., consumers have increasingly pressured companies to produce more environmentally friendly products. Companies have

responded with marketing campaigns to enhance recycling. Our results show that consumers already place positive utility of packaging recyclability and that providing additional information only showed an increase with the video treatment. Since the video showed information on the amount of energy saved in a more easily understandable format, companies should focus on particular reasons to recycle rather than promoting recycling in general.

A large portion, 38.5%, of respondents reported confusion about which labels indicate that a packaging product is recyclable. Companies should focus their marketing efforts on clearing up confusion on label meanings and recognition, rather than encouraging general recycling habits. The study also shows that consumers are more sensitive to cleaning material than the number of parts or the material of the packaging. Identifying barriers to packaging recycling in the U.S. is an essential first step in order for the packaging industry to mitigate these barriers and enhance overall recycling rates.

# APPENDICES

## Appendix A: Statistics for Select Recycling Habits

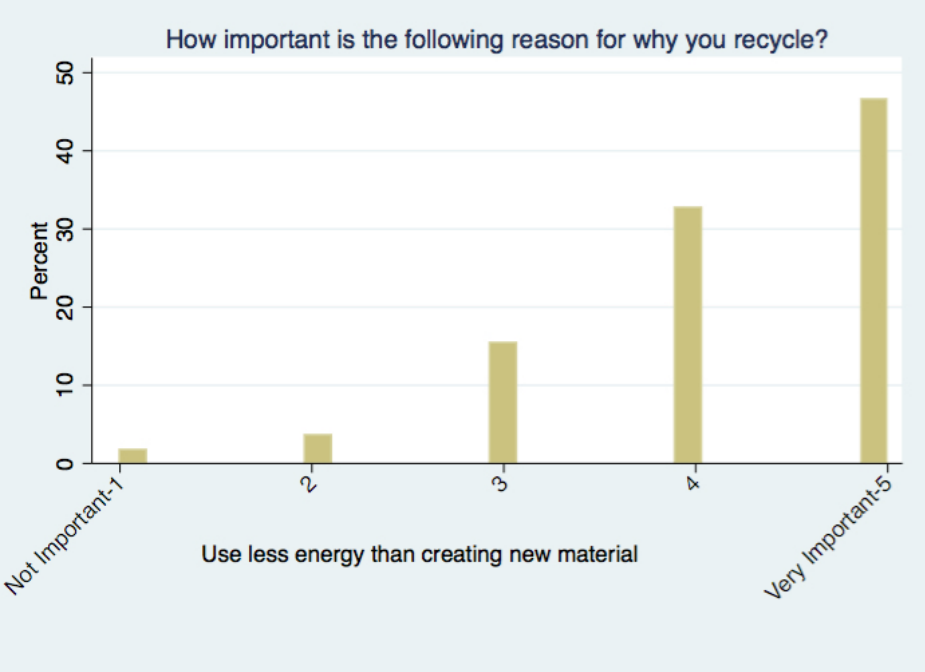


Figure A-1: Importance of energy when deciding to recycle

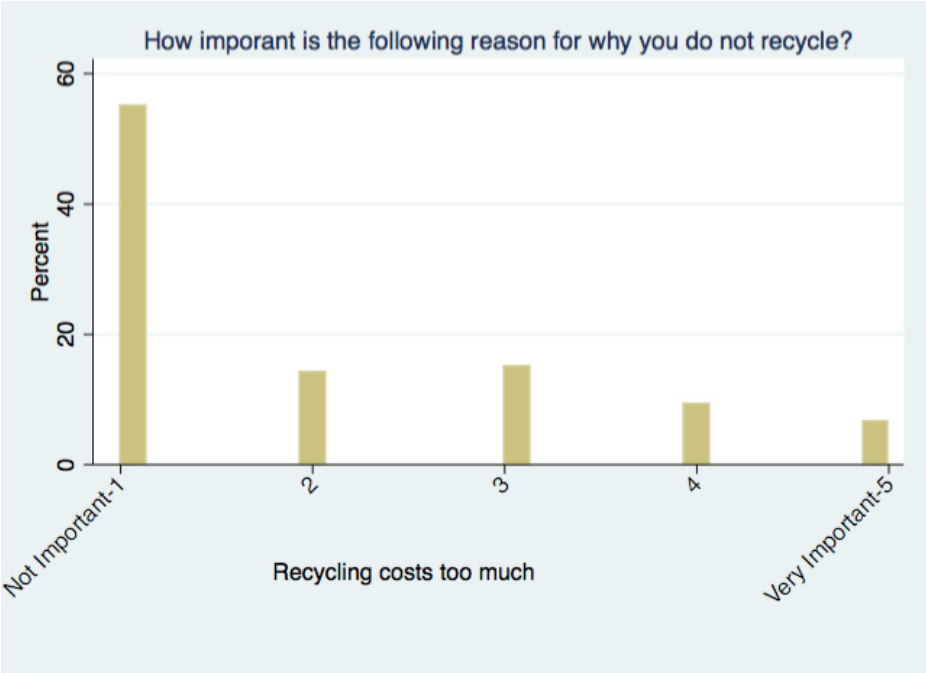


Figure A-2: Importance of cost when deciding to recycle


Figure A-3: Importance of time when deciding to recycle

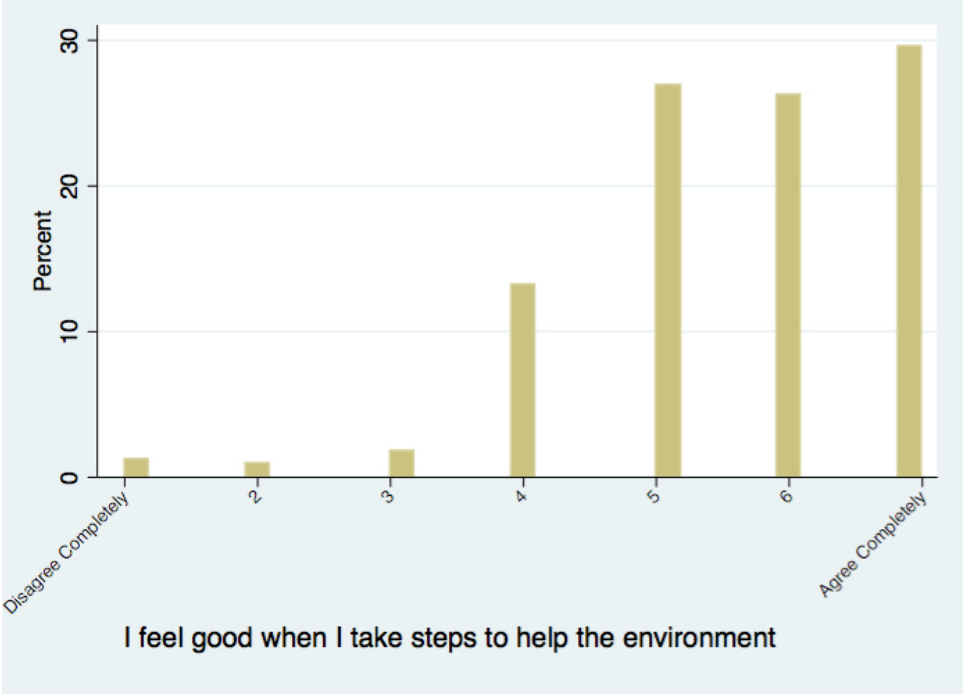


Figure A-4: Environmental Warm Glow

## Appendix B: Full Survey

**Informed Consent**

This is a research survey designed to obtain information from U.S. households on recycling behavior and preferences for food packaging. *Your participation in this survey is entirely voluntary and your responses will be kept in strict confidence.*

**Food Purchasing Habits**

1) Do you make your household food purchasing decisions?
    - Yes
    - No [IF NO, THEN INDIVIDUAL WAS SCREENED OUT]

2) On average how much does your household spend on groceries each week?
    - Less than $25
    - $25-49
    - $50-99
    - $100-$124
    - $125-$149
    - $150-$199
    - $200-$249
    - $250-$299
    - $300 or more
    - Do not know

3) On average how much does your household spend on food away from home each week?
    - Less than $50
    - $50-99
    - $100-$124
    - $125-$149
    - $150-$199
    - $200-$249
    - $250-$299
    - $300 or more
    - Do not know

4) Where do you buy the majority of your household's groceries?
    - Dollar stores
    - Mega-stores (ex: super-Wal-Mart or super-target)
    - Local grocery chain
    - Regional grocery chain
    - Farmers markets
    - Specialty Stores
    - Warehouse clubs
    - Drugstores
    - Convenience Stores

5) On average, how often do you go to a grocery store?
    - Once a month
    - Twice a month
    - Once a week
    - Two times a week
    - Three times a week
    - Four times a week
    - More than four times a week
    - Other

6) How often do you buy fast food?
    - Every day
    - Several times a week
    - About once a week
    - Once or twice a month
    - A few times a year
    - Never

7) Please rank your preferences for the following characteristics from most to least important:
    - Local
    - Organic
    - Non-GMO
    - Humane treatment of animals
    - "Green" packaging
    - Sustainable
    - Natural

8) Which of the following categories do you consider while grocery shopping? (choose all that apply)
    - Quick/no preparation
    - Inexpensive
    - Lactose-free
    - Gluten-free
    - Organic
    - Fair-trade
    - Vegan
    - Vegetarian
    - Local
    - On-the-go
    - Non-GMO

**Packaging, Environmental Attitudes and Recycling Behavior**

9) How important is packaging in your food purchasing decisions?
[LIKERT SCALE FROM 1(NOT IMPORTANT)-5 (EXTREMELY IMPORTANT)]

10) Please rank the following packaging descriptions from most environmentally friendly to least
- Packaging made from recycled materials that cannot be recycled
- Packaging that can be recycled and that is made from recycled materials
- Packaging that can be recycled and that is made from raw materials
- Packaging made from plant-based materials that cannot be recycled
- Packaging made from plant-based materials that can also be recycled
- Packaging that is biodegradable
- Reusable packaging
- Reduced/minimalist packaging

11) Please indicate your attitudes towards the following statements

| | Disagree Completely | Disagree Mostly | Somewhat Disagree | Neither Agree Nor Disagree | Somewhat Agree | Agree Mostly | Agree Completely |
|---|---|---|---|---|---|---|---|
| I am very confused about what is good and bad for the environment | | | | | | | |
| New technologies will surely come along to solve environmental problems before they get out of hand | | | | | | | |
| Some pollution is inevitable if we are going to continue to make improvements in our standard of living | | | | | | | |
| I just don't have the time to worry about how all of my actions affect the environment | | | | | | | |
| I feel good when I take steps to help the environment | | | | | | | |
| I would be embarrassed if people I know caught me not recycling | | | | | | | |
| Local governments should provide more incentives for people to recycle | | | | | | | |

12) Where have you learned the most about sustainable packaging and the effects of recycling?
    - Word-of-mouth
    - News media
    - Food retailers
    - TV programming other than news
    - Advertisements
    - Social media and blogs
    - Other

13) How often do ***you*** recycle your household goods?
    - Never
    - Rarely
    - Sometimes
    - About half of the time
    - Most of the time
    - Always

14) How often does ***your household*** recycle?
    - Never
    - Rarely
    - Sometimes
    - About half of the time
    - Most of the time
    - Always

15) How often would you say ***your neighbors*** recycle their household goods?
    - Never
    - Rarely
    - Sometimes
    - About half of the time
    - Most of the time
    - Always

16) How often would you say the ***average American*** recycles their household goods?
    - Never
    - Rarely
    - Sometimes
    - About half of the time
    - Most of the time
    - Always

17) How often do you recycle products made from the following materials?

| | Never | Rarely | Sometimes | About half of the time | Most of the time | Always |
|---|---|---|---|---|---|---|
| Glass | | | | | | |
| Paper | | | | | | |
| Plastic | | | | | | |
| Aluminum/Tin | | | | | | |

18) How have your recycling habits changed in comparison to one year ago?
- Increased
- Decreased
- Stayed the same

19) When you buy fast food, where do you most commonly dispose of the packaging and food waste?
- Household
- Road-side trash bin
- In-store
- Work location
- Other

20) The following chart lists several packaging characteristics that someone may consider when deciding to recycle a product. For each product, please indicate which factor most influences your decision to recycle:

| | **Plastic beverage bottle** | **Glass pickle jar** | **Cereal box** | **Soda can** | **Shampoo bottle** | **To-go hot beverage cup (paper)** |
|---|---|---|---|---|---|---|
| Bulkiness | | | | | | |
| Effort Required to recycle | | | | | | |
| Time needed to recycle the packaging | | | | | | |
| Having to clean residual product from the package | | | | | | |
| Presence of a recycling label | | | | | | |
| Obtaining a rebate for recycling | | | | | | |

21) Recycling labels- To the best of your abilities match the following labels to their meaning:


A


B


C


D


E

Please match the symbols to what they represent:

Anti-litter symbol

- Made out of Recyclable Tin
- What type of plastic the product is made out of
- Made out of recyclable plastic
- The manufacturer of this product contributes to recovery and recycling costs
- Product made from at least 30% plant-based material
- Made from sustainably sourced forests
- Universal recycling symbol
- Product is compostable
- Made from recycled materials
- Do not know

22) Does your community have a recycling program?

Yes No Do not know

23) Does your neighborhood have pick-up or curbside recycling?

Yes No Do not know

24) What types of recycling programs do you participate in?

- Curbside recycling
- Community drop-off recycling
- Store take back recycling
- In store rebate recycling
- Do not recycle
- Other

25) What materials does your local recycling program accept?

i. Glass
ii. Aluminum
iii. Plastic
iv. Paper
v. Cardboard
vi. Carton
vii. Do not know

-

26) How important are the following reasons for why you recycle?

| | Least Important | Not Very Important | Somewhat Important | Very Important | Most Important |
|---|---|---|---|---|---|
| Reduce waste sent to landfills | 1 | 2 | 3 | 4 | 5 |
| Protect wildlife | 1 | 2 | 3 | 4 | 5 |
| Reduce water pollution | 1 | 2 | 3 | 4 | 5 |
| Use less energy than creating new material | 1 | 2 | 3 | 4 | 5 |
| Cheaper goods in the long run | 1 | 2 | 3 | 4 | 5 |
| General sustainability | 1 | 2 | 3 | 4 | 5 |
| Mandated in your area | 1 | 2 | 3 | 4 | 5 |
| Cheaper than trash pickup | 1 | 2 | 3 | 4 | 5 |

27) How important are the following reasons for why you do **not** recycle?

| | Least Important | Not Very Important | Somewhat Important | Very Important | Most Important |
|---|---|---|---|---|---|
| Recycling takes too much time | 1 | 2 | 3 | 4 | 5 |
| Recycling costs too much | 1 | 2 | 3 | 4 | 5 |
| Not remembering to recycle | 1 | 2 | 3 | 4 | 5 |
| Recycling takes too much effort | 1 | 2 | 3 | 4 | 5 |
| No recycling bin available | 1 | 2 | 3 | 4 | 5 |
| Recycling does not make a difference for the environment | 1 | 2 | 3 | 4 | 5 |
| Recycling guidelines are too confusing | 1 | 2 | 3 | 4 | 5 |
| No recycling program in your area | 1 | 2 | 3 | 4 | 5 |
| No curbside pickups | 1 | 2 | 3 | 4 | 5 |

28) Where do you normally buy your single-serve bottled drinks?

1. In a grocery store
2. From a vending machine
3. At a fast-food restaurant
4. At a convenience store

5. At a gas-station
6. Other

29) How often do you drink some type of fruit juice?
- Several times a day
- Once a day
- Several times a week
- A few times a month
- Once a month
- A few times a year
- Never

30) Which of the following fruit juices do you prefer to buy?
- National/named brand
- Store/generic brand
- Local brand
- Generic

31) Which material do you prefer your single-serve juice packaging to be made out of?
- Plastic
- Glass
- Carton
- Aluminum can
- No preference

32) What type of fruit juice do you normally drink?
- Orange
- Apple
- Lemon
- Multi-fruit
- Grape
- Berry
- Kiwi & strawberry
- Coconut
- Mango
- Vegetable/fruit blend
- Other

Information Treatments Were Shown Here

The next portion of this survey presents you with five hypothetical fruit juice purchasing scenarios that you could face in a retail store where you typically shop. The four products that will be presented in each scenario possess the same characteristics (for example, color, brand, flavor, etc.) except for varying levels of the characteristics presented below such as product price. For each scenario, please select the bottle of fruit juice that you would purchase, or 'I would not

purchase any of these products', if you would not purchase any of the fruit juice products. For your information in interpreting alternative bottles of fruit juice, keep in mind the following characteristics:

**Product price** refers to the cost per 12-ounce (single serve) unit of fruit juice:

- **$0.75/12-ounce unit**
- **$1.00/12-ounce unit**
- **$2.00/12-ounce unit**
- **$3.00/12-ounce unit**

**Packaging material** refers to the material of the bottle that the fruit juice is served/packaged in:

- **Glass**
- **Plastic**
- **Carton**
- **Aluminum can**

**Recyclable** refers to whether the packaging product is recyclable:

- **Yes** means that the product packaging is recyclable
- **No** means that the product packaging is **not** recyclable

The experience from previous similar surveys is that people often state a higher willingness to pay than what one actually is willing to pay for the good. It is important that you make your selections like you would if you were actually facing these choices in your retail purchase decisions, noting that allocation of funds to these products means you will have less money available for other purchases. **Please select on the "I choose" line below the option that you would purchase from each of the following scenarios:**

**EXAMPLE OF THE CHOICE EXPERIMENT**

33)

| **Characteristics** | **Option 1** | **Option2** | **Option 3** | **Option 4** | **Option 5** |
|---|---|---|---|---|---|
| **Material** | Plastic | Glass | Carton | Aluminum can | I would not |
| **Recyclable** | Yes | No | No | No | purchase any of |
| **Price ($/12-ounce unit)** | $3.00 | $2.00 | $3.00 | $1.00 | these products |
| **I would choose** | ○ | ○ | ○ | ○ | ○ |

34)

| Characteristics | Option 1 | Option2 | Option 3 | Option 4 | Option 5 |
|---|---|---|---|---|---|
| **Material** | Plastic | Glass | Carton | Aluminum can | I would not |
| **Recyclable** | Yes | Yes | Yes | Yes | purchase any of |
| **Price ($/12-ounce unit)** | $3.00 | $1.00 | $0.75 | $0.75 | these products |
| **I would choose** | ○ | ○ | ○ | ○ | ○ |

35)

| Characteristics | Option 1 | Option2 | Option 3 | Option 4 | Option 5 |
|---|---|---|---|---|---|
| **Material** | Plastic | Glass | Carton | Aluminum can | I would not |
| **Recyclable** | No | Yes | Yes | No | purchase any of |
| **Price ($/12-ounce unit)** | $1.00 | $3.00 | $2.00 | $3.00 | these products |
| **I would choose** | ○ | ○ | ○ | ○ | ○ |

36)

| Characteristics | Option 1 | Option2 | Option 3 | Option 4 | Option 5 |
|---|---|---|---|---|---|
| **Material** | Plastic | Glass | Carton | Aluminum can | I would not |
| **Recyclable** | No | No | Yes | Yes | purchase any of |
| **Price ($/12-ounce unit)** | $0.75 | $3.00 | $1.00 | $3.00 | these products |
| **I would choose** | ○ | ○ | ○ | ○ | ○ |

37)

| Characteristics | Option 1 | Option2 | Option 3 | Option 4 | Option 5 |
|---|---|---|---|---|---|
| **Material** | Plastic | Glass | Carton | Aluminum can | I would not |
| **Recyclable** | No | No | Yes | No | purchase any of |
| **Price ($/12-ounce unit)** | $0.75 | $0.75 | $0.75 | 0.75 | these products |
| **I would choose** | ○ | ○ | ○ | ○ | ○ |

The next portion of this survey presents you with five hypothetical scenarios where you will have to choose which product you would most likely recycle. The two products that will be presented in each scenario will contain the same food prior to disposal (for example, a 'to go' sandwich) and are assumed to be the same except for varying levels of the characteristics presented below. For each scenario, please select the packaging that you would most likely recycle, or 'I would not recycle either of these', if you would not recycle any of the packaging options. For your information in interpreting the difference in product packages:

**Material** refers to the packaging of the to go container:

- **Plastic**
- **Paper/boxboard**

**Cleaning** refers to whether you must clean the packaging in order for it to be recyclable:

- **Yes**- the packaging must be rinsed or cleaned before it can be recycled
- **No**- the packaging does not have to be rinsed or cleaned for it to be recycled

**Time** refers to how long it takes to clean and/or take apart the packaging for recycling:

- This is indicated in seconds. Please take the time to picture yourself preparing each of the packages in order to get a more accurate response.

**Number of parts** of the packaging that go into different recycling/trash bins:

- **1**: the packaging does not have to be taken apart to be recycled
- **2 or more**: the packaging requires disassembling in order to be recyclable.
    - Examples include: removing a cap from a bottle or removing a non-recyclable plastic film from a recyclable cardboard box or other recyclable material.

The experience from previous similar surveys is that people often state a higher effort level to recycle than what one will actually put into recycling. It is important that you make your selections like you would if you were actually facing these choices as you would in your household, please note that your answers will be used to influence food packaging companies and will have real world effects. **Please select on the "I would recycle" line below the option that you would recycle from each of the following scenarios:**

**EXAMPLE OF THE CHOICE EXPERIMENT**

38)

| **Characteristics** | **Option 1** | **Option 2** | **Option 3** |
|---|---|---|---|
| **Material** | Plastic | Plastic | |
| **Cleaning** | No | Yes | I would not recycle |
| **Parts** | 1 | 1 | either of these |
| **Time** | 5 sec | 60 sec | |
| **I would recycle** | ○ | ○ | ○ |

39)

| Characteristics | Option 1 | Option 2 | Option 3 |
|---|---|---|---|
| **Material** | Paper/boxboard | Plastic | |
| **Cleaning** | No | No | I would not recycle |
| **Parts** | 3 | 3 | either of these |
| **Time** | 10 sec | 20 sec | |
| **I would recycle** | ○ | ○ | ○ |

40)

| Characteristics | Option 1 | Option 2 | Option 3 |
|---|---|---|---|
| **Material** | Plastic | Paper/boxboard | |
| **Cleaning** | Yes | Yes | I would not recycle |
| **Parts** | 1 | 3 | either of these |
| **Time** | 60 sec | 5 sec | |
| **I would recycle** | ○ | ○ | ○ |

41)

| Characteristics | Option 1 | Option 2 | Option 3 |
|---|---|---|---|
| **Material** | Paper/boxboard | Paper/boxboard | |
| **Cleaning** | Yes | No | I would not recycle |
| **Parts** | 4 | 4 | either of these |
| **Time** | 20 sec | 60 sec | |
| **I would recycle** | ○ | ○ | ○ |

42)

| Characteristics | Option 1 | Option 2 | Option 3 |
|---|---|---|---|
| **Material** | Paper/boxboard | Plastic | |
| **Cleaning** | Yes | No | I would not recycle |
| **Parts** | 2 | 1 | either of these |
| **Time** | 5 sec | 5 sec | |
| **I would recycle** | ○ | ○ | ○ |

43) How influential are the following reasons in increasing your recycling behavior:

| | A major influence | A minor influence | No influence | Do not know |
|---|---|---|---|---|
| I see my friends and people I know recycle | | | | |
| My friends and people I know encourage me to recycle | | | | |
| Government officials encourage me to recycle | | | | |
| A non-profit encourages me to recycle | | | | |
| A celebrity I respect encourages me to recycle | | | | |
| I see news media encouraging recycling | | | | |
| I see public notices from my community encouraging recycling | | | | |
| I hear people promoting the benefits of recycling | | | | |
| I hear people talking about the dangers of not recycling | | | | |
| There is a financial incentive to recycle | | | | |
| There is a financial penalty to not recycle | | | | |

**Demographic Background:**

44) I am: Male Female

45) I am _____ years old [TYPE IN]

46) Your highest level of education completed is:

- Did not graduate from high school
- Graduated from high school, did not attend college
- Graduated from high school, currently attending college
- Attended College, No Degree earned
- Attended College, Associates or Trade Degree earned

- Attended College, Bachelor's (B.S. or B.A.) Degree earned
- Graduate or Advanced Degree (i.e. M.S., M.A., Ph.D., J.D., M.D., etc.)
- Other

47) Your annual pre-tax household income is:
- Less than $20,000
- $20,000- $39,999
- $40,000- $59,999
- $60,000- $79,999
- $80,000- $99,999
- $100,000- $149,999
- $150,000- $200,000
- More than $200,000

48) In which state and ZIP code is your main residence?
- State:  ZIP code: (TYPE IN)

49) What best describes where you live?
- A mobile home
- A one-family house detached from any other house (single family home)
- A one-family house attached to one or more houses (townhome)
- A building with 2 apartments/condos
- A building with 3-5 apartments/condos
- A building with more than 6 apartments/condos
- Boat, RV, van etc.
- Other

50) What is your main political reference or affiliation:
- Democrat
- Republican
- Independent
- Libertarian
- Green Party
- Tea Party
- Other

51) How many people are currently living in your household? Please include yourself in the count
- One
- Two
- Three
- Four
- Five
- Six
- Seven
- Eight

- Nine or more

52) Which of the following sectors would your primary current employment fall under?
    - Construction
    - Manufacturing
    - Utilities
    - Retail
    - Transportation
    - Information and Technology
    - Financial and business services
    - Education
    - Health Care
    - Social Work
    - Leisure and Hospitality
    - Federal Government
    - State or Local government
    - Agriculture
    - Homemaker
    - Unemployed
    - Student
    - Military
    - Retired
    - Other

53) What is your race?
    - White
    - Hispanic or Latino
    - Black or African American
    - Native American
    - Asian
    - Pacific Islander
    - Other

54) How do you commute to work?
    - Car
    - Walk
    - Bike
    - Public transportation
    - Other

Thank you for your time in completing this survey. Your input will strengthen our research and help us obtain more accurate conclusions. If you wish to add any comments please feel free to do so here:

## Appendix C: Packaging Recyclability Choice Experiment Estimations

Table A-1: Packaging recyclability choice experiment in preference space

| | Control | | Indirect Questioning | | Infographic | | Video | |
|---|---|---|---|---|---|---|---|---|
| | Mean | 95% CI | Mean | 95% CI | Mean | 95% CI | Mean | 95% CI |
| *Packaging Recyclability* | 1.46 | [1.27, 1.65] | 0.54 | [0.40, 0.67] | 1.51 | [1.29, 1.74] | 1.67 | [1.44, 1.90] |
| *Plastic Packaging* | 2.19 | [2.02, 2.37] | 2.8 | [2.61, 2.99] | 2.05 | [1.88, 2.23] | 2.13 | [1.94, 2.33] |
| *Glass Packaging* | 2.03 | [1.85, 2.21] | 2.2 | [2.01, 2.39] | 1.89 | [1.72, 2.07] | 1.98 | [1.79, 2.16] |
| *Carton Packaging* | 1.79 | [1.61, 1.96] | 2.12 | [1.93, 2.31] | 1.72 | [1.55, 1.90] | 1.71 | [1.51, 1.92] |
| *Aluminum Can Packaging* | 1.46 | [1.28, 1.65] | 2.32 | [2.13, 2.53] | 1.49 | [1.31, 1.68] | 2.32 | [2.13, 2.53] |
| N | 2500 | | 2500 | | 2500 | | 2505 | |
| No. of parameters | 6 | | 6 | | 6 | | 6 | |
| Log-likelihood | -3246 | | -3235 | | -3389 | | -3409 | |
| Pseudo R-Squared | 0.16 | | 0.14 | | 0.14 | | 0.13 | |
| AIC | 2.6 | | 2.59 | | 2.7 | | 2.72 | |

Table A-2: Packaging recyclability choice experiment in WTP-Space

| | Control | | Indirect Questioning | | Infographic | | Video | |
|---|---|---|---|---|---|---|---|---|
| | Mean | 95% CI | Mean | 95% CI | Mean | 95% CI | Mean | 95% CI |
| | 1.31 | [1.14, 1.48] | 0.49 | [0.40, 0.57] | 1.41 | [1.26, 1.56] | 1.62 | [1.45, 1.78] |
| | 2.1 | [1.96, 2.24] | 2.86 | [2.64, 3.09] | 1.93 | [1.83, 2.04] | 2.05 | [1.92, 2.18] |
| | 2.1 | [1.94, 2.25] | 2.29 | [2.07, 2.51] | 1.74 | [1.62, 1.86] | 2.03 | [1.90, 2.17] |
| | 1.79 | [1.64, 1.94] | 2.16 | [1.93, 2.39] | 1.63 | [1.52, 1.75] | 1.64 | [1.49, 1.78] |
| | 1.52 | [1.67, 1.37] | 2.39 | [2.17, 2.60] | 1.45 | [1.32, 1.57] | 1.59 | [1.46, 1.73] |
| N | 2500 | | 2500 | | 2500 | | 2505 | |
| No. of parameters | 18 | | 18 | | 18 | | 18 | |
| Log-likelihood | -2992 | | -2940.1 | | -3132.4 | | -3153.2 | |
| Pseudo R-Squared | 0.256 | | 0.269 | | 0.221 | | 0.218 | |
| AIC | 2.41 | | 2.37 | | 2.52 | | 2.53 | |

## Appendix D: Individual WTP for Packaging Material by treatment group- OLS robust regressions

Table A-3: Individual WTP for plastic packaging by treatment group

| Plastic Packaging | | | | |
|---|---|---|---|---|
| | Control | Indirect Questions | Infographic | Video |
| Female | 0.041 | 0.055* | 0.112*** | 0.016 |
| | (0.048) | (0.029) | (0.040) | (0.040) |
| Age | 0.008 | 0.000 | 0.006 | -0.012* |
| | (0.009) | (0.006) | (0.007) | (0.007) |
| Age Squared | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Education | -0.008 | -0.006 | -0.029** | 0.006 |
| | (0.015) | (0.009) | (0.012) | (0.012) |
| Income | 0.003 | -0.005 | 0.035*** | -0.017 |
| | (0.015) | (0.010) | (0.013) | (0.013) |
| White | -0.145** | -0.006 | 0.074 | 0.010 |
| | (0.062) | (0.039) | (0.050) | (0.052) |
| Democrats | 0.046 | -0.039 | 0.085* | 0.045 |
| | (0.054) | (0.037) | (0.046) | (0.048) |
| Republicans | -0.033 | 0.007 | 0.114** | 0.087* |
| | (0.064) | (0.037) | (0.053) | (0.051) |
| Urban Continuum | 0.005 | 0.003 | 0.010 | -0.002 |
| | (0.016) | (0.009) | (0.013) | (0.011) |
| Constant | 2.146*** | 2.923*** | 1.659*** | 2.385*** |
| | (0.191) | (0.140) | (0.163) | (0.181) |
| Observations | 500 | 500 | 500 | 501 |
| R-squared | 0.04 | 0.022 | 0.055 | 0.026 |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A-4: Individual WTP for glass packaging by treatment group

| Glass Packaging | | | | |
|---|---|---|---|---|
| | Control | Indirect Questions | Infographic Treatment | Video Treatment |
| Female | 0.068 | 0.030 | 0.052 | 0.049 |
| | (0.057) | (0.030) | (0.044) | (0.057) |
| Age | -0.005 | 0.009 | 0.009 | 0.012 |
| | -0.010 | -0.006 | -0.008 | -0.009 |
| Age Squared | 0.000 | 1.05E-04* | 0.000 | 1.70E04* |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Education | 0.055*** | 0.005 | 0.005 | -0.001 |
| | (0.017) | (0.009) | (0.013) | (0.016) |
| Income | -0.008 | 0.011 | 0.007 | 0.030* |
| | (0.016) | (0.008) | (0.014) | (0.016) |
| White | 0.051 | -0.004 | -0.085 | 0.106* |
| | (0.068) | (0.036) | (0.061) | (0.063) |
| Democrats | 0.042 | 0.032 | 0.065 | -0.044 |
| | (0.067) | (0.035) | (0.053) | (0.065) |
| Republicans | 0.126* | 0.051 | 0.054 | -0.118* |
| | (0.075) | (0.037) | (0.056) | (0.070) |
| Urban Continuum | 0.002 | 0.002 | 0.012 | -0.021 |
| | (0.017) | (0.010) | (0.015) | (0.016) |
| Constant | 1.877*** | 2.033*** | 1.573*** | 1.725*** |
| | (0.205) | (0.124) | (0.185) | (0.210) |
| Observations | 500 | 500 | 500 | 501 |
| R-squared | 0.029 | 0.018 | 0.027 | 0.034 |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A-5: Individual WTP for aluminum packaging by treatment group

| Aluminum Packaging | | | | |
|---|---|---|---|---|
| | Control | Indirect Questions | Infographic Treatment | Video Treatment |
| Female | -0.110*** | -0.041 | -0.036 | -0.122*** |
| | (0.035) | (0.028) | (0.042) | (0.042) |
| Age | 0.001 | -0.009* | -0.007 | 0.001 |
| | -0.006 | -0.005 | -0.007 | -0.008 |
| Age Squared | 0.000 | 1.01E-04* | 0.000 | 0.000 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Education | -0.016 | 0.000 | -0.002 | -0.029** |
| | (0.011) | (0.008) | (0.013) | (0.013) |
| Income | 0.013 | -0.0184** | 0.000 | -0.011 |
| | (0.010) | (0.008) | (0.013) | (0.013) |
| White | 0.020 | -0.012 | -0.061 | -0.043 |
| | (0.042) | (0.039) | (0.053) | (0.052) |
| Democrats | 0.119*** | 0.002 | 0.002 | 0.037 |
| | (0.042) | (0.034) | (0.047) | (0.046) |
| Republicans | 0.067 | -0.004 | 0.043 | 0.108* |
| | (0.044) | (0.036) | (0.056) | (0.057) |
| Urban Continuum | -0.002 | 0.001 | -0.017 | 0.002 |
| | (0.010) | (0.009) | (0.012) | (0.014) |
| Constant | 1.605*** | 2.653*** | 1.755*** | 1.720*** |
| | (0.130) | (0.134) | (0.170) | (0.163) |
| Observations | 500 | 500 | 500 | 501 |
| R-squared | 0.053 | 0.023 | 0.019 | 0.043 |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table A-6: Individual WTP for carton packaging by treatment group

| Carton Packaging | | | | |
|---|---|---|---|---|
| | Control | Indirect Questions | Infographic Treatment | Video Treatment |
| Female | 0.005 | -0.064* | -0.055 | 0.053 |
| | (0.048) | (0.034) | (0.040) | (0.048) |
| Age | -0.007 | 0.007 | -0.004 | 0.006 |
| | -0.009 | -0.006 | -0.007 | -0.008 |
| Age Squared | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Education | -0.003 | -0.002 | -0.003 | 0.013 |
| | (0.014) | (0.011) | (0.011) | (0.013) |
| Income | 0.000 | 0.018* | 0.000 | 0.014 |
| | (0.014) | (0.011) | (0.013) | (0.013) |
| White | -0.052 | 0.025 | 0.066 | 0.014 |
| | (0.059) | (0.039) | (0.048) | (0.060) |
| Democrats | -0.098* | -0.006 | 0.011 | 0.096 |
| | (0.056) | (0.039) | (0.046) | (0.059) |
| Republicans | -0.063 | -0.058 | 0.008 | -0.056 |
| | (0.064) | (0.042) | (0.052) | (0.056) |
| Urban Continuum | -0.018 | -0.009 | -0.007 | 0.000 |
| | (0.014) | (0.011) | (0.012) | (0.015) |
| Constant | 2.112*** | 2.024*** | 1.698*** | 1.462*** |
| | (0.200) | (0.135) | (0.166) | (0.197) |
| Observations | 500 | 500 | 500 | 501 |
| R-squared | 0.018 | 0.026 | 0.01 | 0.031 |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

## Appendix E: Barriers to Recycling Choice Experiment Supplemental Tables

Table A-7: Estimated Parameters of the barriers to recycling CE in preference space

| | Control | Indirect Questioning | Infographic | Video |
|---|---|---|---|---|
| Time Value | -3.10*** | -4.55*** | -3.33*** | -3.73*** |
| Material | -0.01 | 0.00 | 0.02 | 0.01 |
| Cleaning | -0.13*** | -0.25*** | -0.16*** | -0.16*** |
| Parts | -0.04 | -.06** | 0.01 | -0.04 |
| No. of parameters | 4 | 4 | 4 | 4 |
| Log-likelihood | -2324 | -2432 | -2284 | 2249 |
| AIC | 1.81 | 1.836 | 1.77 | 1.74 |

Table A-8: Determinants of Individual WTA to clean by treatment group

| | Control | Indirect Questioning | Infographic | Video |
|---|---|---|---|---|
| Female | -0.014 | -0.006 | 0.000 | -0.003 |
| | (0.011) | (0.008) | (0.012) | (0.010) |
| Age | 0.002 | 0.002 | -0.001 | 0.001 |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| Age Squared | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Education | -0.002 | -0.001 | -0.003 | -0.001 |
| | (0.003) | (0.002) | (0.004) | (0.003) |
| Income | 0.000 | -0.001 | 0.002 | 0.001 |
| | (0.003) | (0.002) | (0.004) | (0.003) |
| White | -0.020 | -0.009 | -0.042*** | -0.020 |
| | (0.014) | (0.010) | (0.016) | (0.012) |
| Democrats | 0.016 | 0.013 | 0.013 | 0.023** |
| | (0.013) | (0.009) | (0.015) | (0.012) |
| Republicans | -0.005 | 0.014 | 0.023 | 0.029** |
| | (0.015) | (0.010) | (0.016) | (0.013) |
| Urban Continuum | 0.000 | 0.000 | 0.001 | 0.004 |
| | (0.003) | (0.003) | (0.004) | (0.003) |
| Price Sensitive | 0.000 | 0.001 | -0.002 | -0.005 |
| | (0.006) | (0.004) | (0.006) | (0.005) |
| Time Sensitive | 0.001 | 0.004 | 0.001 | 0.011** |
| | (0.006) | (0.004) | (0.006) | (0.005) |
| Recycle for Energy Reasons | 0.019*** | 0.009** | 0.007 | 0.003 |
| | (0.006) | (0.004) | (0.007) | (0.006) |
| Recycling Confusion | -0.001 | -0.011 | 0.020 | -0.012 |
| | (0.022) | (0.014) | (0.024) | (0.016) |
| Environmental Warm-glow | -0.008 | -0.007** | 0.005 | 0.004 |
| | (0.005) | (0.003) | (0.005) | (0.004) |
| Constant | -0.123** | -0.088** | -0.117* | -0.138*** |
| | (0.054) | (0.039) | (0.064) | (0.049) |
| Observations | 467 | 461 | 460 | 458 |
| R-squared | 0.047 | 0.052 | 0.037 | 0.044 |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

## Appendix F: Differences in WTP for packaging materials

Table A-9: T-test mean differences for packaging materials within treatment groups

| | Plastic Packaging | Glass Packaging | Carton Packaging |
|---|---|---|---|
| Control | | | |
| *Glass Packaging* | \$0.00<br>(0.994) | | |
| *Carton Packaging* | \$0.31***<br>(0.00) | \$0.31***<br>(0.01) | |
| *Aluminum Can Packaging* | \$0.58***<br>(0.00) | \$0.58***<br>(0.00) | \$0.27***<br>(0.01) |
| Indirect Questioning | | | |
| *Glass Packaging* | \$0.57***<br>(0.00) | | |
| *Carton Packaging* | \$0.70***<br>(0.00) | \$0.13<br>(0.42) | |
| *Aluminum Can Packaging* | \$0.48***<br>(0.00) | \$0.09<br>(0.56) | \$0.22<br>(0.16) |
| Infographic | | | |
| *Glass Packaging* | \$0.19**<br>(0.02) | | |
| *Carton Packaging* | \$0.31***<br>(0.00) | \$0.11<br>(0.19) | |
| *Aluminum Can Packaging* | \$0.49***<br>(0.00) | \$0.30***<br>(0.00) | \$0.19**<br>(0.03) |
| Video | | | |
| *Glass Packaging* | \$0.014<br>(0.88) | | |
| *Carton Packaging* | \$0.41***<br>(0.00) | \$0.40***<br>(0.00) | |
| *Aluminum Can Packaging* | \$0.45***<br>(0.00) | \$0.44***<br>(0.00) | \$0.04<br>(0.69) |

*Note: P-values in parentheses *** p<0.01, ** p<0.05, * p<0.1

Mean WTP for packaging materials were tested within treatment groups. Consistently throughout all treatment groups, WTP for plastic packaging was valued the most with significant differences from carton and aluminum packaging.

## Appendix G: Individual WTP for packaging recyclability

Table A-10: Individual WTP for packaging recyclability by treatment group

| WTP for packaging Recyclability | Control | Indirect Questioning | Infographic | Video |
|---|---|---|---|---|
| Female | 0.061 | 0.091** | 0.069 | -0.030 |
| | (0.094) | (0.037) | (0.101) | (0.101) |
| Age | -0.009 | 0.006 | -0.041** | -0.027 |
| | (0.02) | (0.01) | (0.02) | (0.02) |
| Age Squared | 0.000 | 0.000 | 3.8E-04** | 0.000 |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| Education | 0.022 | -0.010 | 0.005 | -0.006 |
| | (0.030) | (0.010) | (0.030) | (0.032) |
| Income | 0.032 | 0.017 | 0.019 | -0.035 |
| | (0.030) | (0.011) | (0.030) | (0.031) |
| White | -0.003 | -0.090* | 0.149 | 0.073 |
| | (0.120) | (0.046) | (0.134) | (0.128) |
| Democrats | 0.006 | -0.032 | 0.127 | -0.031 |
| | (0.108) | (0.044) | (0.119) | (0.121) |
| Republicans | -0.183 | 0.023 | -0.159 | -0.110 |
| | (0.126) | (0.044) | (0.121) | (0.135) |
| Urban Continuum | 0.020 | 0.003 | 0.006 | 0.018 |
| | (0.026) | (0.011) | (0.032) | (0.031) |
| Price Sensitive | -0.026 | 0.025 | 0.012 | -0.109** |
| | (0.046) | (0.016) | (0.048) | (0.048) |
| Time Sensitive | -0.100** | -0.026 | -0.092* | 0.020 |
| | (0.046) | (0.018) | (0.050) | (0.049) |
| Recycle for Energy Reasons | 0.0856* | 0.021 | -0.011 | 0.128** |
| | (0.050) | (0.019) | (0.052) | (0.063) |
| Recycling Confusion | -0.400* | 0.050 | -0.305* | -0.051 |
| | (0.213) | (0.061) | (0.185) | (0.155) |
| Environmental Warm-glow | 0.140*** | 0.015 | 0.185*** | -0.002 |
| | (0.043) | (0.015) | (0.044) | (0.046) |
| Constant | 0.432 | 0.161 | 1.311** | 2.165*** |
| | (0.466) | (0.199) | (0.570) | (0.473) |
| Observations | 467 | 461 | 460 | 458 |
| R-squared | 0.109 | 0.045 | 0.094 | 0.049 |

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

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