

A BEHAVIORAL ECONOMIC APPROACH TO GREEN CONSUMERISM: DEMAND FOR REUSABLE SHOPPING BAGS

Brent A. Kaplan¹
Brett W. Gelino
Derek D. Reed
University of Kansas

ABSTRACT: The success of behavioral economics is underscored by its emerging role in informing public policy. While applied behavioral economics has almost exclusively investigated pharmacological issues or the reinforcing efficacy of stimuli used in educational and clinical settings, we propose that this technology can be applied to the understanding and promotion of sustainable purchases in the American marketplace. Many communities have begun to adopt measures promoting such sustainable purchasing, but a conceptual understanding of proper pricing for these “green” products is lacking. An empirical foundation upon which to model prices can aid in generating revenue for distributors while simultaneously nudging sustainable decision-making on the part of the consumer. This report describes a study that successfully translates behavioral economic concepts to demand for sustainable products. A secondary contribution is the demonstration of relations between behavioral economic demand indices and scores on the New Ecological Paradigm Scale (i.e., construct validity), a renowned scale used by environmental psychologists and ecological economists.

KEYWORDS: behavioral economics, consumer behavior, demand, green consumerism, New Ecological Paradigm Scale, sustainability

Behavioral economics provides a framework and methodology for understanding behavior by integrating principles of behavioral science and microeconomics. The field of behavioral economics (see Hursh, 1980, 1984; Hursh & Roma, 2016; Reed, Niileksela, & Kaplan, 2013) has made great strides toward understanding patterns of abuse and excessive consumption on both an individual and population scale (Hursh & Roma, 2016). Perhaps no better example of the scalability of behavioral economics is in applied behavioral pharmacology, through which behavioral economic considerations have made significant advances in the understanding, treatment, and prevention of substance abuse (see Jarmolowicz, Reed, & Bickel, 2014). Such a behavioral economic approach involves both *delay discounting* (i.e., the extent to which a reward

¹ Brent Kaplan is now at the Virginia Tech Carilion Research Institute, Virginia Polytechnic Institute and State University. Correspondence concerning this article should be addressed to Derek D. Reed, Department of Applied Behavioral Science, University of Kansas, 4048 Dole Human Development Center, 1000 Sunnyside Avenue, Lawrence, KS 66045-7555. E-mail: dreed@ku.edu. The authors thank Pete Roma and Steve Hursh for their helpful insight and guidance on our analyses.

is devalued due to its delayed receipt) and *operant demand* (i.e., the extent to which an organism defends its free operant consumption of a commodity amidst increasing constraints).

Although delay discounting has demonstrated utility in understanding principles and processes related to sustainable decisions (e.g., Berry et al., 2017; Kaplan, Reed, & McKerchar, 2014), operant demand has demonstrated utility in providing specific guidance on environmental policy regarding price structuring, such as in fuel pricing/taxation (e.g., Reed, Kaplan, Roma, & Hursh, 2014; Reed, Partington, Kaplan, Roma, & Hursh, 2013). It has thereby been proposed that demand assessments begin to be translated to policy-related issues in healthcare, sustainability, and beyond (see Hursh & Roma, 2013).

Recent years have been met with the progression of resource-efficient demand assessments, which aid the behavioral economist in better understanding issues of societal concern through the lens of excessive consumption and risky decision making (see Roma, Hursh, & Hudja, 2016; Roma, Reed, DiGennaro Reed, & Hursh, 2017). The hypothetical purchase task, now the field standard for evaluating individual demand, has been applied to a multitude of products including alcohol (Murphy & MacKillop, 2006; Murphy, MacKillop, Skidmore, & Pederson, 2009; see also Kiselica, Webber, & Bornovalova, 2016), cigarettes (MacKillop et al., 2008; Murphy, MacKillop, Tidey, Brazil, & Colby, 2011), marijuana (Collins, Vincent, Yu, Liu, & Epstein, 2014), indoor-tanning services (Reed, Kaplan, Becirevic, Roma, & Hursh, 2016), and other drugs of abuse (e.g., cocaine; Bruner & Johnson, 2014). A primary advantage of this approach is the ability to model market fluctuations and purchasing in situations where real-world price ranges are insufficient for post-hoc analyses of demand curves (e.g., price ranges too restricted to detect breakpoints or elasticity; e.g., Reed et al., 2014) or when experiential manipulations are impractical (e.g., oil prices on transportation use; e.g., Reed et al., 2013). Thus, demand analysis has potential to provide novel insights into issues of societal importance, remaining conceptually systematic with behavior analysis while rendering direct guidance on cost framing targets such as excise taxation rates or rebate/incentive amounts.

A contemporary issue of significant societal importance is global climate change resulting from human behavior. As discussed in detail elsewhere (Chance & Heward, 2010; Heward & Chance, 2010; Luke & Alavosius, 2012; see also Mattaini & Aspholm, 2016; Mattaini & Luke, 2014), behavior analysis has great potential to address the many behavioral contributions to a shifting global climate. One small step toward this end is to behaviorally engineer consumer preference for sustainable products (Carlsson & Johansson-Stenman, 2012; Layng, 2010).

One of the most visible attempts to nudge consumers toward sustainable purchasing (i.e., “green consumerism”; see review by Peattie, 2010) is the rise of retail stores’ offering of, and encouragement to use, reusable shopping bags (Lesser, 2010). Many communities and local government agencies have begun to employ a variety of push and pull methods to force a reduction in the use of polyethylene-type single-use shopping bags (e.g., de Groot, Abrahamse, & Jones, 2013; Jakovcetic et al., 2014; Muralidharan & Sheehan, 2016). In the U.S. alone, over 250 ordinances have been passed outright banning single-use shopping bags, while a range of other behavioral adjustments are being utilized, not limited to associated fees or taxes, consumer education, and mandated distributor recycling programs (Wagner, 2017). Communities that restrict bag use through such fees or bans have observed dramatic reductions in their use and concurrent increases in reusable shopping bag applications (see Martinho, Balaia, & Pires, 2017).

Work examining the subjective value of single-use bags in light of impending taxes found that, on average, individuals in medium- to upper-tax brackets are more likely to begin using reusable bags when faced with contingent fees (i.e., push methods), as compared to methods

intended to promote voluntary adoption of reusable bags (i.e., pull methods; Dunn, Caplan, & Bosworth, 2013). Further, participants reporting lower socioeconomic statuses indicated a far greater affinity for reusable bags when subsidization was available, given the relative upfront costs associated with their use (Dunn et al., 2013). To our present knowledge, there is no peer-reviewed behavioral evidence regarding price structures for reusable bags—the absence of which provides an excellent opportunity for behavioral economic inquiry.

The primary aim of the present study was to evaluate the utility of behavioral economic demand curves (generated from a hypothetical purchase task [HPT]) to describe potential consumers' demand elasticity for reusable shopping bags. We hypothesize that responses on the task will closely resemble the prototypical downward-sloping curve found in nearly all previous demand curve studies and be explained by a contemporary demand equation (Equation 1 described below). A secondary aim was to determine whether behavioral economic measures would predict scores on the New Ecological Paradigm Scale (NEPS; Dunlap, Van Liere, Mertig, & Jones, 2000), considered to be the most widely used scale of pro-environmental tendencies and a psychometrically sound indicator of willingness-to-pay for sustainable commodities (Dunlap, 2008). We hypothesize that purchasing at no cost and purchasing sensitivity to price will significantly relate to scores on the NEPS. Our “proof-of-concept” approach to this study has several possible outcomes. First, demonstrating the utility of behavioral economic approaches to measuring demand and informing price structuring for sustainable goods could provide an impetus for future behavior analytic research. Second, the implications of such research could aid policy makers and marketing specialists in the promotion of sustainable products. Third, behavioral validation of a widely used and cited measure of environmental concern could aid in the dissemination of behavior analytic approaches and considerations to related fields such as environmental psychology or environmental economics.

Method

Participants and Setting

Seventy-six undergraduate students enrolled in an introductory behavioral science course, aged 19 to 33 ($M = 20.88$ years, $SD = 2.30$), participated to receive .5% of extra credit. Participants completed computerized questionnaires in a large room (9 m x 6 m) containing 18 Dell® OptiPlex computers equipped with 17-inch flat-panel monitors, keyboards, and mice. Approximately 12 participants were tested during each 30-minute experimental session.

Hypothetical Purchase Task

Upon entering the lab, participants were informed they would be answering computerized questions. The computerized instructions informed participants that the questions concerned hypothetical purchases, that they should imagine themselves in the situations, and to honestly answer each question. The experimenter then launched the HPT, which was displayed using Qualtrics® Research Suite (see <http://www.qualtrics.com>). The HPT employed in the current study was adapted from Jacobs and Bickel (1999) and consisted of a hypothetical vignette that prompted participants to report the quantity of reusable bags they would be willing to purchase at varying price points (note that this approach also meets the field standards as described by Roma et al., 2016). The vignette featured in the HPT was worded to resemble Jacobs and Bickel's (1999) demand curve assessments as closely as possible. Although the scenario may sound contrived, it

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was necessary to set objective constraints (e.g., standardizing grocery amount, time spent on vacation) to attempt to minimize participants' subjective idiosyncratic influences (see Bickel et al., 2017). The vignette read as follows:

In the questionnaire that follows, we would like you to pretend to purchase reusable shopping bags. Imagine that you and your friends are on vacation in a city far away from where you live and are picking up groceries at a supermarket. This supermarket is locally owned and operated and not available in your hometown. Upon entering the supermarket, you are offered the chance to buy and use reusable shopping bags, instead of using the store's paper/plastic ones. These reusable bags are not available at the checkout. The following questions ask how many bags you would purchase at various prices. These reusable bags are standard size and hold approximately the same amount as paper/plastic ones. Assume that you did not bring your own bags with you, and that you need to purchase about a week's worth of groceries (about \$100 worth). You will only be at the supermarket once this week and will not be able to reuse the bags at this supermarket ever again. You cannot use one of your friends' bags. Also, assume that the bags you are about to purchase are for your use only. In other words, you can't sell the bags or give them to anyone else. Everything you buy is, therefore, for your own personal use today and in the future at your local supermarket. Please respond to these questions honestly, as if you were actually in this situation.

Below the vignette presentation, participants were presented with the following question (free-condition in parentheses): *How many bags would you purchase (take) if they were \$X.XX each?* Participants responded by inputting their reported purchase into a text box immediately below the question using the provided keyboard. The price per bag increased in ascending order across questions (and pages) to include the corresponding array of values: \$0.00 (free), \$0.25, \$0.50, \$1.00, \$1.50, \$2.00, \$2.50, \$3.00, \$4.00, \$5.00, \$6.00, \$7.00, \$8.00, and \$9.00. Therefore, the same vignette was displayed at the top of the page, but each page contained a different price per bag. A "next" button was available at the bottom of the page that allowed participants to proceed to the subsequent question.

NEPS

Following the HPT, participants completed the 15-item NEPS (Dunlap et al., 2000), a 5-point Likert type scale (ranging from "Strongly Agree" to "Strongly Disagree") argued to assess a variety of dimensions including attitudes, beliefs, and values towards the environment. The measure contains a combination of pro- (e.g., "Plants and animals have just as much right as humans to exist.") and anti-ecological statements (e.g., "Humans were meant to rule over the rest of nature.") that describe various aspects of the relationship between humans and the environment. Scores range between 15 and 75, where higher scores reflect more acceptance with the NEPS and thus greater ecological concern (Dunlap et al., 2000). The currently employed version of the scale was found to correlate with a previously validated installation of the NEPS ($r = .61$; Dunlap et al., 2000; Dunlap & Van Liere, 1978), thus demonstrating adequate predictive qualities (Noe & Snow, 1990).

Data Analysis

We analyzed individual and group data using Koffarnus, Franck, Stein, and Bickel's (2015) exponentiated version of Hursh and Silberberg's (2008) exponential demand model (Equation 1), which states:

$$Q = Q_0 \cdot 10^{k(e^{-\alpha \cdot Q_0 \cdot C} - 1)} \quad \text{Equation 1}$$

where Q represents purchasing, Q_0 represents the *intensity* of demand or “purchasing” when the price of the commodity is free, k is the range of quantity purchased in logarithmic units, C represents price, and α describes the change in elasticity across the range of prices. For the purposes of the current experiment, we defined *essential value* as the inverse of $\alpha(1 / \alpha)$, constrained Q_0 to the individuals' (or groups' average) first response (i.e., How many bags would you take if they were \$0.00 [free]?), and set k to a constant equal to $\log(Q_0)$ or $\log(Q_0 / \text{purchasing at the highest price point})$, depending on individually reported purchasing across price points.²

Of the initial 76 datasets, four (5.2%) were identified as nonsystematic using Stein, Koffarnus, Snider, Quisenberry, and Bickel's (2015) nonsystematic purchase task data identification tool with limitations set for the following criteria: trend ($[\Delta Q]$; 0.025), bounce (B; 0.10), and reversals from zero (0); datasets identified as nonsystematic were removed from further analysis. An additional five (6.6%) datasets were identified and removed for limited responding, the criterion for which was set as purchasing reported at only free price (e.g., lack of monetary expenditure³), resulting in a final sample of 67 datasets.

Using the above-described parameters and replacing “free” with \$0.01 for both curve-fitting and graphing purposes (i.e., $\log(0)$ is undefined and cannot be plotted on the figure; the “Free” price on the abscissa depicts “purchasing” at \$0.00 using a split axis), curves were fit to each dataset, in turn providing an estimation of change in demand elasticity (i.e., α). After obtaining α , we sought to calculate other demand indices which might provide a more informative evaluation of reusable bag purchasing. Foremost was observed $P_{\max}$, or the price point at which observed maximum response output occurs (determined by multiplying purchasing by each related price, the maximum value of which is $O_{\max}$)⁴.

For each dataset, two forms of breakpoint (as described by Roma et al., 2016) were calculated: *breakpoint₁* (BP_1), or the price point just before zero purchasing, and *breakpoint₀* (BP_0), or the first price point at which an absence of purchasing is reported (i.e., $Q = 0$; for those who reported purchasing at the greatest price point, BP_1 was set to \$9.00 and BP_0 was set to \$10.00, or the next logical price point in the sequence).

² The use of the exponentiated demand model allowed the inclusion of zeros when relevant. Thus, in some cases, analysis of data sets included examination of purchasing at and beyond *breakpoint₀* (BP_0 ; see text for details). Because $\log(0)$ is undefined, in these cases we constrained individual k to $\log(Q_0)$. For cases in which BP_0 corresponded with a value greater than any surveyed price point, k was constrained to $\log(Q_0 [\text{maximum purchasing value}] / \text{purchasing at greatest price point} [\text{minimum purchasing value}])$. Note that data aggregation prevented occurrences of zero at any surveyed price point. Additionally, we acknowledge the limitations introduced by our approach of calculating subject-specific k values (i.e., different value for each respective dataset). However, because no direct comparisons are made between α values, this is an acceptable procedure for obtaining the best-fit curves.

³ Because our interest focused on the extent to which individuals will defend their use of reusable bags in the face of increasing cost, we necessarily excluded individuals reporting a lack of bag purchases at initial cost.

⁴ Note that $P_{\max}$ and $O_{\max}$ reported here were directly observed from the data and not derived from the demand indices in Equation 1.

Results & Discussion

The exponentiated demand equation (Equation 1) fit the data well, with a median R^2 of .86 across the 67 datasets ($IQR = .72-.91$). Median essential value (i.e., the rate at which purchasing declines as price increases) was 18.23 ($IQR = 7.35-44.47$) with a median demand intensity (Q_0 ; i.e., the amount of “purchasing” when bags cost \$0.00) of 8 bags ($IQR = 5-10$). Observed values of $P_{\max}$ (i.e., the price at which purchasing begins to decrease at a disproportionally greater rate than increases in price) and $O_{\max}$ (i.e., the total amount of money willing to expend to purchase the bags) were found to yield medians of \$2.00 ($IQR = \$1.00-\2.75) and \$6.00 ($IQR = \$3.00-\9.00), respectively. The median BP_1 (i.e., the highest price that still resulted in bag purchases) value was \$3.00 ($IQR = \$1.75-\6.00), and the median BP_0 (i.e., the first price that resulted in no bags purchased) value was \$4.00 ($IQR = \$2.25-\7.00). Finally, the median total NEPS score was 39 ($IQR = 35-44.5$).

For comparison purposes, we examined group level demand (i.e., aggregated purchasing values for each price across participants in the group) between the 1st and 4th quartiles of participants with respect to NEPS scores (i.e., scores < 35, > 44.5, respectively). The left panel of Figure 1 depicts the demand curves fitted to these aggregate data and the right panel of Figure 1 depicts expenditure curves, or the *total* amount of money expended on purchasing all bags at a given price (i.e., price per bag $\times$ the number of bags purchased), calculated based on the fitted demand curves. Equation 1 described both quartiles well (R^2 values > .99). An extra-sum-of-squares F -test evaluated the null hypothesis that variance is reduced using a single curve (i.e., a shared α value) through both sets of data. Results of this analysis of variance in the curve fit suggest separate curves to describe the separate datasets ($F_{1,25} = 226.4$, $p < .0001$; see Figure 1). Interestingly, intensity of demand was strongest (higher Q_0 ; depicted as bags purchased at “free” price) in the *lowest* NEPS quartile, despite that dataset featuring more elastic demand (i.e., purchasing decreased relatively quickly with increases in price). We interpret this finding as suggesting that individuals identified as less “green” (lower NEPS scores) may be more likely to *take* more of a product than what they need if that product is free, but demonstrate greater sensitivity to prices for these sustainable products (and thus are less likely to pay for them as price increases).

Table 1 displays the correlations among behavioral economic indices of demand and the NEPS at the individual level⁵. Greater resistance to increasing price (as estimated via α in our study) significantly predicted scores on the NEPS ($\rho = -0.24$); essential value ($\rho = 0.23$) and $O_{\max}$ ($\rho = 0.22$) also demonstrated marginal relations to scores on the ecological scale. Given the NEPS is intended to measure ecological concern, these data offer evidence to support the notion that those who score higher on the scale (and thus have greater ecological concern) are willing to expend more resources (e.g., money) to purchase a sustainable product. These data serve as “proof of concept” of the utility of the HPT beyond substances of abuse, which has largely been the focus of previous applications (e.g., alcohol, Murphy & MacKillop, 2006; cigarettes, MacKillop et al., 2008; marijuana, Collins et al., 2014), thus adding to the growing literature on adapting the core features of the HPT to other products (e.g., toilet paper, fine-dining; Roma et al., 2016).

⁵ Note the expected inverse relation between demand elasticity (α) and intensity at the individual level, counter to what is observed in the aggregate curves in the left panel of Figure 1.

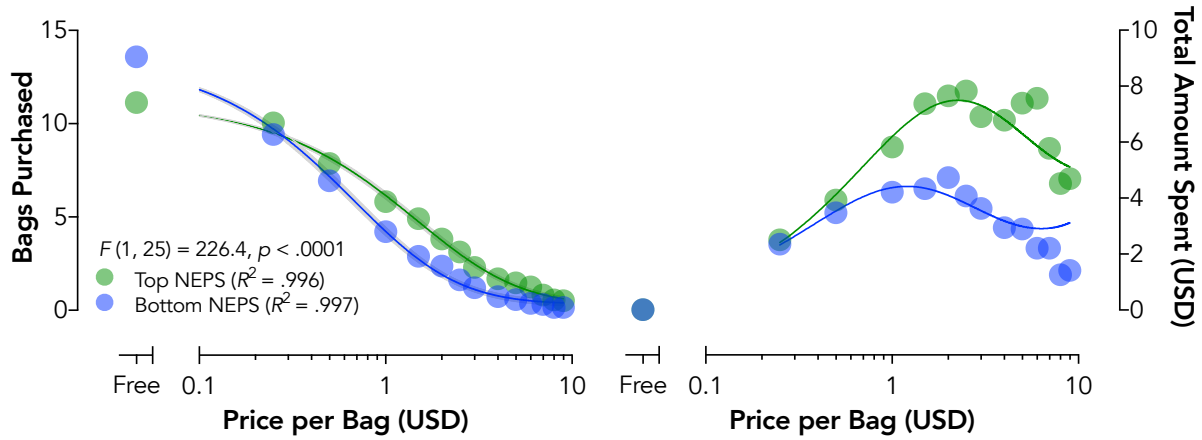


Figure 1. Aggregate demand (left panel) and expenditure (right panel) curves of top and bottom NEPS scorers (as grouped by 1st and 4th quartiles), plotted across price points. Narrowly shaded bands indicate 95% confidence intervals. “Free” price represents responding at the \$0.01 price point. Individuals who score lower on the NEPS report taking more bags when free, but demonstrate more sensitivity to increasing price (higher α), as compared to those who scored higher on the NEPS (see text for details).

Table 1. Spearman’s Rho correlation coefficients between individual-level behavioral economic indices and environmental ratings

	Alpha (α)	Essential Value	Intensity	$P_{\max}$	$O_{\max}$	Breakpoint	NEPS
Alpha (α)	--						
Essential Value	-0.94**	--					
Intensity	-0.69**	0.44**	--				
$P_{\max}$	-0.59**	0.73**	0.04	--			
$O_{\max}$	-0.95**	0.98**	0.49**	0.76**	--		
Breakpoint	-0.78**	0.86**	0.25*	0.86**	0.86**	--	
NEPS	-0.24*	0.23 [†]	0.15	0.17	0.22 [†]	0.18	--

Note. Essential Value = $1/\alpha$, $P_{\max}$ = maximum price, $O_{\max}$ = maximum expenditure, NEPS = New Environmental Paradigm Scale

[†] $p < .10$ (marginal significance); * $p < .05$; ** $p < .0001$

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Previous research on the exponential demand model (Hursh & Silberberg, 2008) has identified moderate to strong correlations between all behavioral economic indices of demand, with the exception of the relation between intensity and $P_{\max}$ (e.g., Murphy et al., 2011). Little work, however, has been done to demonstrate these same relations when employing the exponentiated (Koffarnus et al., 2015) demand model. This study serves as both a replication of such relations, which may lend confidence to the construct validity of our purchase task for an environmentally sustainable product, and as an extension of these findings to a new domain—that of the exponentiated demand equation. As evidenced in Table 1, correlations between indices of demand replicated those found in other HPT studies (e.g., Murphy et al., 2011), providing support for the use of the current purchase task and application of the demand model. Furthermore, a relatively small percentage of our sample (5%) met criteria for identification of nonsystematic responding (Stein et al., 2015), providing additional support for the purchase task.

Beyond describing the relation between behavioral economic demand and proenvironmental preferences, this study offers implications to policy makers and marketing specialists interested in promoting sustainable purchasing. Specifically, $O_{\max}$ and $P_{\max}$ can be used to help estimate pricing for sustainable purchases to maximize revenue without producing the elastic demand that would result in less purchasing of sustainable products (in favor of less sustainable items due to price elasticity). For example, the present study found that the median price point at which demand became significantly elastic (i.e., $P_{\max}$) was \$2.00, representing the maximum price that our sample was willing to pay for a single reusable bag before potential purchasing significantly decreased (i.e., became elastic). At this price point, the model suggests that a retailer would generate a median of \$6.00 in maximum revenue ($O_{\max}$) per consumer.

Given the proof-of-concept nature of the current experiment and relatively homogeneous participant sample, we do not hasten to make any pricing suggestions based on the prices that we found here. Rather, we illustrate the potential utility of the behavioral economic approach to achieve certain goals, whether they be to increase reusable bag purchasing, increase profitability, or simply to provide an alternative measure of environmentally-related behavior. With many communities imposing restrictions on single-use bags, achieving a better understanding of practical pricing structures for reusable bags could be of particular benefit to meeting many of these goals. Similar studies could aid in informing empirical public policy and price structuring to support sustainable purchasing of related goods and services (cf. Hursh & Roma, 2013).

Improving said rates of sustainable purchasing may have manifold effects for business owners. Recent literature suggests that companies demonstrating greater alignment with sustainable initiatives receive more favorable evaluations by consumers (Choi & Ng, 2011). This work, in turn, has prompted related research on effective strategies for targeting these eco-friendly consumers, highlighting the need for “green advertising” and other aggressive models that push the sustainability agenda (Noonan & Coleman, 2013; Yang, Lu, Zhu, & Su, 2015). The data and methods presented here could thereby provide a basic framework for increasing marketability of sustainable goods whilst optimizing income and simultaneously demonstrating socially approved business practices. Future research should evaluate the effects of such marketing, framing, or incentivizing of reusable shopping bags through this behavioral economic approach, beginning with simulated tasks with subsequent field/marketplace confirmation research.

Notwithstanding these contributions, the present study is limited by a relatively homogenous participant sample (undergraduate students in the Midwest) and should be interpreted as a “proof of concept” demonstration, rather than an application of consumer behavioral economics. In addition, we did not collect data on actual purchasing behaviors and relied on self-reports; note,

however, that recent research has found that demand for hypothetical and real rewards are significantly correlated (e.g., Amlung, Acker, Stojek, Murphy, & MacKillop, 2012) and such hypothetical tasks demonstrate excellent psychometric properties across all commodities evaluated thus far (see Reed, Kaplan, & Becirevic, 2015). An additional limitation is the specificity in which we worded the vignette used in the HPT (e.g., being on vacation, not being able to share the bags with friends). Although seemingly artificial, these types of assumptions are not only in line with best practices in constructing HPTs (Roma et al., 2016), but are needed to control for extraneous sources of variability. Some of the assumptions ultimately may not be needed, yet the vignette provides at least a beginning framework for future investigations related to sustainable behaviors. Nonetheless, even with the various assumptions imposed, data closely resembled previous data obtained from HPTs with Equation 1 providing excellent fits. Finally, although we found elasticity statistically significantly related to NEPS score, the correlation was weak to moderate. Targeting a more diverse (and potentially experienced) demographic and enhancing task instructions may ultimately result in stronger relations between demand measures and the NEPS. Despite such limitations, this study provides a novel bridge between sustainability efforts and operant demand; we believe such a marriage of inquiry can lead to myriad advances in the push for nudging green consumerism (e.g., Peattie, 2010).

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