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Charles H. Dyson School of Applied Economics and Management
Cornell University, Ithaca, New York 14853-7801 USA

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Bradley J. Rickard, Jura Liaukonyte, Harry M. Kaiser, and Timothy J. Richards

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Bradley J. Rickard, Assistant Professor
Charles H. Dyson School of Applied Economics and Management
Cornell University, Ithaca, NY 14853
Tel: +1.607.255.7417
E-mail: bjr83@cornell.edu

Jura Liaukonyte, Dake Family Assistant Professor
Charles H. Dyson School of Applied Economics and Management
Cornell University, Ithaca, NY 14853

Harry M. Kaiser, Gellert Family Professor
Charles H. Dyson School of Applied Economics and Management
Cornell University, Ithaca, NY 14853

Timothy J. Richards, Morrison Chair
Morrison School of Agribusiness and Resource Management,
W. P. Carey School of Business
Arizona State University, Mesa, AZ 85212

Abstract: Generic promotion and advertising activities have traditionally been used to promote individual agricultural commodities. However, there is renewed interest in implementing a mandatory "broad-based" promotion program for all fruits and vegetables, and this idea is highly controversial among those in the horticultural industry. Here we use data from an experiment that introduces subjects to various promotional efforts for fruits and vegetables to estimate the direct and indirect effects of advertising. Econometric results indicate that commodity-specific promotional efforts may be less effective at increasing demand for fruits and vegetables than earlier studies have suggested, yet such campaigns do appear to have a significant clockwise rotational effect on the demand for fruits and vegetables. Broad-based advertising does have a direct effect on the demand for fruits and vegetables, and after controlling for various demographic differences between treatments our results show that average willingness-to-pay for fruits and vegetables was 41% higher among subjects in the broad-based group compared to the control group.

Key words: Advertising; Experimental economics; Fruits and vegetables; Willingness to pay

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Growers of many fruits and vegetables in the United States contribute to state or federal promotion and research programs through mandatory assessments. These programs are designed to improve producer incomes by either shifting demand (promotion) or lowering costs (research). Generic promotion and advertising activities are generally "commodity-specific" meaning they are aimed at increasing the demand only for the individual commodity using funds collected from the producers of that commodity. Most economic research on commodity specific promotion efforts for agricultural products indicates that the benefits from such programs have far exceeded the costs (e.g., Ferrero et al. 1996; Alston et al. 2007), however, there is also some evidence that commodity groups, particularly those in the meat industry, seem to advertise more than what would be collectively optimal (Alston, Freebairn and James 2001).

Recently, there has been interest in implementing a mandatory "broad-based" generic promotion program for all fruits and vegetables. Unlike commodity-specific, broad-based promotion activities attempt to enhance the demand for all fruits and vegetables rather than just one commodity. Broad-based advertising programs for fruits and vegetables have featured large-scale media efforts in the United Kingdom (*5 a Day* campaign), Australia (*Go for 2&5*® campaign), and Canada (*5 to 10 a day* campaign). In the United States, broad-based campaigns for fruits and vegetables have been less visible, and have had much less media exposure than their counterparts in other regions. The *5-A-Day For Better Health* program was introduced by the National Institute of Cancer and the Produce for Better Health Foundation (PBH) in 1991.[1] In 2007, the PBH and the Centers for Disease Control and Prevention unveiled a new program called *Fruit and Veggies—More Matters*. This new program was created in an effort to align the fruit and vegetable marketing campaign with the nutrition recommendations published in the

Dietary Guidelines for Americans by the USDA; however, it continues to operate on a modest budget that is funded by license fees for the use of PBH promotional materials and by voluntary contributions from producers, food and farm associations, food distributors, and agricultural companies (PBH, 2010).

The idea of a mandatory checkoff program for broad-based advertising of fruits and vegetables is highly controversial among horticultural producers, and the ensuing debate has included much speculation from both sides of the argument. Whether commodity-specific or broad-based promotional efforts would lead to greater sales of fruits and vegetables has been questioned by industry stakeholders (see Prevor 2009), and there is no clear consensus among growers and packers on this issue. Some fruit and vegetable producers see commodity-specific programs competing for "stomach share" in a destructive game of advertising competition whereas broad-based programs have the capacity to increase sales for all fruits and vegetables. Others in the industry are less supportive of broad-based advertising because the central message in these programs may simply emphasize an already well known fact—that eating a diet rich in fruits and vegetables is good for your health—and believe that such promotion efforts will have little impact on the demand for these products. Among those questioning the efficacy of broad-based campaigns, there are also concerns about the distributive implications across fruits and vegetables; a broad-based effort might provide benefits for a subset of products rather than increase demand for all fruits and vegetables. Unfortunately, there is little research on the economic impacts of such programs, which would be useful to guide the industry debate.

Traditionally, research in this arena has focused on three main views of advertising: (1) *persuasive*, in which advertising creates spurious differentiation and increases consumers' willingness-to-pay (WTP) for a product (Dixit and Norman, 1978), (2) i*nformative*, which allows

previously uninformed consumers to learn about the product, and about the match between their preferences and product attributes (Nelson 1970; Nelson 1974), and (3) *complementary*, in which consumers draw utility from both the advertised product and advertising itself (Stigler and Becker 1977; Becker and Murphy 1993). The empirical identification and quantification of these effects is troublesome without making a priori assumptions of how advertising affects demand. Ackerberg (2001, 2003) argues that informative advertising affects consumers who have never tried the product, whereas persuasive advertisements affect both initial and repeat buyers, and finds a large and significant informative effect of advertising and an insignificant persuasive effect. While informative advertising is expected to shift demand outward, it is also expected to rotate the demand curve counter-clockwise (more elastic) as consumers become aware of alternatives. Persuasive advertising, on the other hand, is expected to rotate demand clockwise. Clearly, because producer welfare gains from advertising require higher prices, growers would prefer a clockwise to a counter-clockwise rotation. Neither of these schools of thought is clear on the mechanism by which this rotation occurs, however.

Johnson and Myatt (2006) develop a fundamentally new perspective on how advertising works. Rather than simply shifting demand, advertising in their model operates on the dispersion of consumer valuations for the product. If the valuation of the marginal consumer (the last consumer to buy the product as the price rises) is greater than the mean, an increase in the dispersion of valuations will rotate demand clockwise, thus increasing the marginal WTP. A truly generic advertising program would reduce the dispersion of demand and, if the marginal consumer has a valuation below the mean, a counter-clockwise rotation will reduce the marginal WTP. Both broad-based and commodity-specific advertisements could have informative and persuasive effects on consumer behavior. The purpose of this paper is to apply the theoretical

framework from Johnson and Myatt (2006) and test it with data collected in a series of economic experiments using several broad-based, commodity-specific, and mixed advertisements for fruits and vegetables.

The experiment developed in this research allows us to shed some new light on an issue that is both timely and important to industry stakeholders. It also provides results that contribute to the literature examining the economic effects of generic advertising for agricultural products in three significant ways. First, very few studies have used experimental economics to evaluate consumer response to promotional efforts for agricultural products (a notable exception is Messer et al. 2009). Many econometric studies have examined the effects of generic advertising using secondary aggregate consumption and advertising expenditures data (e.g., Vande Kamp and Kaiser 1999; Schmit and Kaiser 2004; Alston et al. 2007; Adachi and Liu 2010). An experimental approach is a viable alternative for measuring consumer response to advertising because the lab offers an excellent way to control for other factors that affect consumer demand in order to isolate the effects of advertising. Compared to survey methods, our incentive-compatible experiment also elicits non-hypothetical WTP values. Second, our research is the first to empirically measure the economic effects of both broad-based advertising and commodity-specific advertising for fruits and vegetables. Previous work has examined the effectiveness of specific broad-based campaigns (*e.g.*, Heimendinger et al. 1996; Pollard et al., 2008) and commodity-specific campaigns (*e.g.*, Forker and Liu 1988; Richards 1999; Kaiser, Liu, and Consignado 2003) for fruits and vegetables, but earlier research has not quantified and compared the likely implications of adopting these two advertising approaches. Third, our analysis assesses how commodity-specific and broad-based advertising influence demand for fruits and vegetables, as either shifts or rotations in demand, and facilitates a test of the theory

outlined by Johnson and Myatt (2006). Zheng, Kinnucan, and Kaiser (2008) find some evidence that advertising rotates the demand for selected beverage products, but uses secondary data in a demand-systems approach. Our study is the first to use primary data to measure the rotational impacts on demand from advertising in food and agricultural markets.

Model

Broad-based or category-level advertising is directed to the "mass market" as it is expected to shift out the demand curve and minimize the dispersion of valuations. Because the marginal consumer has a valuation below the mean in the sense of Johnson and Myatt (2006), a counter-clockwise rotation will raise the valuation of the marginal consumer and, hence, profits for the industry as a whole. In our application, advertising that seeks to increase demand for fruits and vegetables generally cannot emphasize specific attributes because products differ substantially within the category. Advertising designed to increase demand for fresh produce can only highlight the most generic attributes (e.g., fresh fruit and vegetables are healthy foods).

Commodity-specific advertising represents messaging that attempts to increase the dispersion of valuations among fresh produce consumers, thereby rotating the demand curve clockwise and raising the valuation of the marginal consumer. In this case, the marginal consumer has a valuation that is above the mean, and this clockwise rotation serves to increase their WTP, and thus raise profits. Apple advertising, for example, should emphasize attributes found in apples that may not appeal to all consumers such as sweetness and crispness. When both types of advertising are considered together, the dominant effect will be the one that achieves the desired effect on valuation dispersion. If broad-based advertising dominates, then dispersion will fall, demand will rotate counter-clockwise and the WTP of the marginal consumer will rise. However, if the commodity-specific effect is dominant, then a clockwise

rotation will increase the WTP for the specific commodity, and reduce the valuation of the commodity group as a whole.

More formally, consider the definition of a rotation in the demand curve described by Johnson and Myatt (2006). Assume there is a unit mass of consumers, each willing to pay *w* for one unit of the item in question. The distribution of *w* is represented by $F_s(w)$, which is twice continuously differentiable in both *s* and *w* with density $f_s(w)$. The parameter *s* governs the shape of the distribution of valuations such that an increase in *s* represents a spread in the density of *w* and, hence a clockwise rotation of $F_s(w)$, about some point $\hat{w}$. Next we derive the effect of a spread in valuations on the distribution of market demand. At any price, *p*, the proportion of consumers who purchase the good is given by: $q = 1 - F_s(p)$. Inverting this expression gives an expression for the inverse demand curve: $P_s(q) = F_s^{-1}(1-q)$, so a change in *s* rotates the inverse demand curve in a manner analogous to the change in the distribution of valuations. Namely, if demand is below the pivot point, $\hat{q}$ then an increase in the spread of valuations causes a rise in the market price, and *vice versa*, or:

$$q < \hat{q} \Rightarrow \frac{\partial P_s(q)}{\partial s} > 0, \quad q > \hat{q} \Rightarrow \frac{\partial P_s(q)}{\partial s} < 0. \tag{1}$$

Equation (1) implies that if we are below the pivot-point in demand, greater dispersion in valuations causes the valuation of the marginal consumer, and hence the market price, to rise and if we are above the pivot-point in demand, an increase in the dispersion of demand causes the price to fall. In the former case, the product is interpreted as a niche, or specialty product, and in the latter a product intended for the mass market.

We use the theoretical framework developed in this model to derive a structural model of broad-based and commodity-specific advertising. We derive the WTP for produce items in a random utility framework in which the distribution of consumer heterogeneity reflects the

distribution of marginal valuations in the theoretical model above. In the random utility model, consumer utility is the sum of a deterministic and stochastic part such that:

$$\boldsymbol{U_{ij} = V_{ij} + \varepsilon_{ij},} \tag{2}$$

for product *j* by consumer *i*, where V_{ij} is the deterministic component of utility, and ε_{ij} is an *iid* error term. Utility, in turn, is a function of demographic attributes of the individual (x_i) and of the product choice (z_j) a vector of advertising exposures (a_k) and income (y_i). The marginal value consumer *i* places on product *j* = 1 is defined as the amount of income that leaves the consumer's utility at least as great with and without the purchase:

$$\boldsymbol{V_{i0}(z_0, a_0, x_i, y_i) + \varepsilon_{i0} \leq V_{i1}(z_1, a_1, x_i, y_i - c_{i1}) + \varepsilon_{i1}} \tag{3}$$

where $\boldsymbol{c_{i1}}$ is the marginal value of product 1 by consumer *i* (Loureiro and Umberger, 2003). We solve for the WTP by consumer *i* by invoking the random utility assumption and recognizing that:

$$\mathbf{Pr}(\boldsymbol{WTP_{il} \geq c_{i1}}) = \mathbf{Pr}(\boldsymbol{V_{i0} + \varepsilon_{i0} \leq V_{i1} + \varepsilon_{i1}}). \tag{4}$$

Assuming the error term is double-exponential distributed with mean 0 and variance $\pi^2\mu^2/3$, where μ is the logit scale parameter, the WTP becomes:

$$\mathbf{Pr}(\boldsymbol{WTP_{il} \geq c_{i1}}) = \frac{\mathbf{exp}\ (\mathbf{V_{i1}}/\boldsymbol{\mu})}{\mathbf{exp}(\mathbf{V_{i1}}/\boldsymbol{\mu}) + \mathbf{exp}\ (\mathbf{V_{i0}}/\boldsymbol{\mu})} \tag{5}$$

Solving for the WTP from this expression, we write the odds ratio of choosing product 1 relative to product 0 as:

$$\frac{\mathbf{Pr}(\boldsymbol{j = 1})}{\boldsymbol{1 - Pr(j = 1)}} = \frac{\mathbf{exp}\ (\mathbf{V_{i1}}/\boldsymbol{\mu})/[\mathbf{exp}(\mathbf{V_{i1}}/\boldsymbol{\mu}) + \mathbf{exp}\ (\mathbf{V_{i0}}/\boldsymbol{\mu})]}{\mathbf{exp}\ (\mathbf{V_{i0}}/\boldsymbol{\mu})/[\mathbf{exp}(\mathbf{V_{i1}}/\boldsymbol{\mu}) + \mathbf{exp}\ (\mathbf{V_{i0}}/\boldsymbol{\mu})]} = \mathbf{exp}\left(\frac{\mathbf{V_{i1}}}{\boldsymbol{\mu}}\right), \tag{6}$$

where *Pr* (*j* = 1) is the probability of purchasing good 1. Taking logs of both sides of the odds ratio gives the expression in equation (7) for the WTP by consumer *i* as a function of choice and

subject attributes, the level of advertising and the scale parameter (which we normalize to 1 without loss of generality in the empirical application shown below):

$$ln\left(\frac{\mathbf{Pr}(j=1)}{1-Pr(j=1)}\right) = WTP_{i1} = \frac{\mathbf{V_{i1}}}{\mu}. \quad (7)$$

With an appropriate specification for $\mathbf{V_{i1}}$ it is possible to test for both the direct effect of broad-based and commodity-specific advertising on the WTP for fresh produce, and the indirect effect through the dispersion of valuations. Assuming that utility is additive over attribute arguments, we specify $\mathbf{V_{i1}}$ in terms of an empirical, or estimable, model of utility in equation (8):

$$V_{ij}(z_j, x_i, a_{mj}) = \alpha_j + \sum_k \beta_k z_{jk} + \sum_l \gamma_l x_{il} \sum_m \delta_m a_{mj} + \xi_j, \quad (8)$$

where α_j is a choice-specific constant, β_k are marginal values for each product attribute, γ_l represent the influence of each demographic attribute on willingness to pay, δ_m is the impact of advertising of type *m* (broad-based, commodity-specific or combination) on indirect utility and ξ_j is the *iid* econometric error term (Berry, 1994). Advertising, however, is hypothesized to have both a direct effect by shifting the demand curve, and an indirect effect through the dispersion of valuations. We model this latter effect by recognizing that the advertising response term is a function of unobserved consumer heterogeneity through the distribution of preferences, represented by F_s. Each advertising-impact parameter is randomly distributed according to:

$$\delta_m = \delta_{m0} + \delta_{m1}\sigma_m + \nu_m, \ \nu_m \sim N(0,1), \quad (9)$$

where δ_{m0} is now interpreted as the direct effect of advertising of type *m* , whereas δ_{m1} is the indirect, or rotational effect caused by changes in the dispersion of valuations, and σ_m is the estimate of variability in tastes associated with each type of advertising. Substituting this utility model into the expression for WTP_{il} provides an estimable model of the impact of advertising on the WTP under each type of advertising.

Four hypotheses concerning the effects broad-based and commodity-specific promotional efforts on the WTP for fruit and vegetable products are tested here. First, we hypothesize that broad-based advertising will lead to a shift in demand for these products (i.e., $\delta_{10} > 0$). Second, and consistent with Johnson and Myatt (2006) we expect that broad-based advertising will reduce the dispersion ($\delta_{11} < 0$) of WTP bids for fruits and vegetables. Third, we hypothesize that commodity-specific advertising will also lead to a shift in demand ($\delta_{20} < 0$), and fourth, that commodity-specific advertising will increase the dispersion across recorded WTP levels ($\delta_{21} > 0$). These four hypotheses are imminently testable through experimental methods. Next we outline the experiment that was developed to collect data for estimating WTP for fruits and vegetables using treatments that introduced subjects to different types of advertising.

Experimental Design

A total 271 adult (non-student) subjects participated in the experimental sessions conducted in a lab designed for experimental economics and decision research. Subjects were paid $25 and were told they could keep the cash or use part of it to purchase grocery items presented in a series of auctions. Subjects were seated randomly at individual computer terminals with privacy shields, and were informed that all decisions they made would be kept strictly confidential. A maximum of 24 computer terminals were available, and the sessions ranged in size from 16 to 24 subjects. After signing a consent form, participants were given a brief introduction on the experiment, which included the amount of money they would earn, rules of the experiment, and that they would view a short media clip before receiving further instructions. The experiment consisted of three parts.

In Part A, subjects watched video clips of the popular animated television series, *The Simpsons*. Three 90-second vintage *Simpsons* episodes were played for subjects in all

treatments.[2] In addition, for all treatments except for the control group, two 30-second television advertisements for fruits and vegetables were included between the first and second *Simpsons* episode, and between the second and third episode in order to mimic how advertisements are generally placed for television shows. Participants were placed into one of six treatments. Treatment 1 was the control group (n=58) where subjects viewed only the three *Simpsons* episodes and no advertisements. Since this was the control group, the number of subjects in this treatment was higher than the remaining treatments. Subjects in Treatment 2, the broad based group (n=41), were shown three *Simpsons* episodes and four 30-second broad-based television advertisements for fruits and vegetables. Two of the commercials featured Australia's campaign called "Go For 2&5" that was designed to increase vegetable and fruit consumption (see http://www.gofor2and5.com.au). The other two broad-based commercials in this treatment were from the U.K.'s "5 A DAY" campaign for fruits and vegetables (see http://www.nhs.uk/livewell/5aday/pages/5adayhome.aspx). Treatment 3, the apple-specific group (n=44), was shown the three *Simpsons* episodes and four 30-second apple-specific television advertisements. Three commercials were for New York State apples, and one commercial was for Washington State apples. Treatment 4 (n=38) was shown broad-based and apple-specific advertisements in between the three *Simpsons* episodes. Here subjects viewed two 30-second broad-based television commercials and two thirty-second apple-specific television advertisements. This treatment featured one Australian and one U.K. broad-based commercial, and one New York State and one Washington State apple commercial. In Treatment 5 (n=42) subjects viewed the three *Simpsons* episodes and four 30-second potato-specific television advertisements. All four potato commercials were for Idaho potatoes. The last group, Treatment 6 (n=48) viewed broad-based and potato-specific advertisements; subjects viewed the three

Simpsons episodes plus two 30-second broad-based television commercials and two thirty-second potato-specific television advertisements.

Rather than include commodity-specific advertisements for several fruits and vegetables, we focus on apples and potatoes for two reasons. First, apples and potatoes are two major commodities in the fruit and vegetable industry in terms of consumption and value (USDA-NASS, 2009). Second, subjects may interpret a series of advertisements for specific fruits and vegetables as a general campaign, and it would become difficult to separate the effects of commodity-specific promotion and broad-based promotion.

Part B of the experiment was designed to teach and demonstrate how the WTP auctions would be conducted. In this practice round subjects submitted bids for a pen and it allowed participants to become familiar with the bidding process that would also be used in the auctions for the fruit and vegetable products in Part C. Part C of the experiment consisted of eight auctions for fruits and vegetables, and the order of the auctions was randomized. For each auction participants started a clock on their computer at $0.00, which increased in $0.10 increments every two seconds to a maximum of $6.00, and they could withdraw from the auction at any time. In each session we auctioned one pound each of apples, oranges, bananas, table grapes, carrots, red bell peppers, Russet potatoes, and tomatoes. Subjects were informed that all items were not organically produced, and were recently purchased from a local supermarket. Subjects were told that only one-half of all auctions would be binding, and that the binding auctions would be randomly determined at the end of the experiment. Because the upper price for each auction was $6.00, there were no satiation or budget constraint effects on WTP decisions. The highest bidders for each item and the number of auctioned items were not revealed until the end of the experiment.

A computerized sealed first price auction was used in parts B and C of the experiment to elicit maximum WTP for each subject. Elyakime, Laffont, Loisel and Voung (1994) showed that in the sealed first price auction the participant's equilibrium strategy is to choose a reservation price equal to his private value. Because of this property, this type of auction is an incentive compatible method of eliciting WTP and is considered to be an auction that is relatively easy for participants to understand (Kagel 1995). The auctions were programmed using Excel spreadsheets and Access databases with Visual Basic for Applications.

At the completion of the experiment, participants were asked to fill out a computerized survey to describe their preferences for fruits and vegetables, likeability of the advertisements used in their session, and several demographic variables including weight, height, age, income, and education. The complete list of survey questions is presented in Appendix A. Table 1 presents the descriptive statistics for all the demographic variables as well as WTP levels grouped by treatment.[3] All the treatments which included broad-based advertising (treatments 2, 4 and 6) have WTP averages that are significantly higher than control; however WTP averages were not higher for treatments exposed to the commodity-specific advertising programs. Table 1 also shows that demographic composition is similar across all six treatments. Next we present a thorough analysis on the effects of commodity-specific and broad-based advertising on the WTP for fruits and vegetables that controls for all of the demographic variables listed in Table 1.

Results

In this section we present the estimation results from applying the WTP model developed above to the data collected in our experiment. We first look graphically at the changes in the distribution of WTP bids under the various advertising treatments. The top left panel in Figure 1 provides an illustration of how the cumulative distribution function (CFD) for WTP bids is

expected to change in the presence of advertising that increases dispersion (Johnson and Myatt, 2006). Each of the other five panels in Figure 1 show CDF from the WTP data for a treatment in our experiment, and each facilitates a comparison to the CDF for the WTP data collected in the control group. In all panels in Figure 1 the dotted line shows the CDF for WTP bids with advertising. We see that the treatments with commodity-specific advertising—panels (c) and (e)—exhibit a clear pattern of clockwise CDF rotation, which is consistent with the increase in WTP dispersion. The three treatments that include broad-based advertising—panels (b), (d), and (f)—show signs of a counter-clockwise CDF rotation and this suggests that broad-based advertising contributes to a decrease in the dispersion of WTP bids. In addition, two of the three treatments that include broad-based advertising—panels (b) and (f)—show a downward shift in the CDF and evidence of a direct effect of advertising.

Table 2 presents the results obtained by estimating a constant parameter Tobit model and a random parameter Tobit (RPT) model. By comparing the two models, we establish whether unobserved heterogeneity, interpreted here as the dispersion of item valuations, is an important feature of the data. Because many bids are zero (Table 1 shows that the share of such bids ranged between 8.55% and 21.88% across treatments), we maintain a Tobit structure of the underlying regression model throughout, and interpret the resulting parameter estimates accordingly. The constant parameter Tobit model is nested within the random parameter model, so we use likelihood ratio (LR) tests to compare the two models. Based on the likelihood function values reported in Table 2, the test statistic value is 38.31 while the critical value with six degrees of freedom (the number of restrictions) at a 5% level is 12.59. Moreover, a Wald test (t-test) of the scale parameters in the random parameter model also suggests rejecting the constant parameter specification in five of the six cases. Therefore, we reject the null hypothesis

that the constant parameter model is preferred and use the random parameter specification to test individual hypotheses regarding the relative effects of the treatments that employ different forms of advertising for fruits and vegetables.

Recall that in the model of preference dispersion of Johnson and Myatt (2006) whether WTP rises or falls as a result of some type of marketing activity depends both on the persuasiveness of the advertisement and its informative content. To examine the persuasiveness component of promotional programs in our experiment we include dummy variables for each treatment. In Table 2, the coefficients in the first six rows describe the mean WTP associated with the presence of a marketing activity (or the absence of a marketing activity in the case of the Control treatment), while the coefficients in the next six rows describe the dispersion of valuation associated with each treatment.

Our first hypothesis states that broad-based advertising increases WTP relative to the control group, and our second hypothesis states that broad-based promotional efforts should inform consumers about the health benefits of eating fruit and vegetables and, thus, should reduce the dispersion of valuations. The results in Table 2 support these two hypotheses. First, the coefficient for the broad-based treatment variable is 0.4403 while it is 0.3123 for the control treatment; it is significantly higher under broad-based compared to control with a t-ratio of 19.65. Second, the coefficient on the dispersion of valuations under broad-based advertising is 0.3070 and it is 0.3857 in the control treatment; the coefficient for the broad-based treatment is significantly lower than the control treatment with a t-ratio of -6.405. This result indicates a decrease in the dispersion of valuation for bids, or a counter-clockwise rotational effect on demand. Therefore, in the broad-based treatment we see both a direct effect and an indirect effect on WTP bids for fruits and vegetables from advertising. Since we control for the "quality"

or influence of the promotional campaigns through a series of advertisement-specific preference questions, we believe that the counter-clockwise rotational effect is relatively important here. This result is particularly important to the design of a broad-based promotional program for fruits and vegetables because it implies that the marginal consumer is not a below-the-mean, mass-market target. Rather, fresh produce consumers resemble niche buyers who respond to advertising that reduces the dispersion of valuations, and broad-based advertising for fruits and vegetables is effective in increasing valuations if it reduces the dispersion of valuations.

Results from subjects exposed to commodity-specific advertising are different from those in the broad-based treatment. In Table 2 we do not see statistically significant direct effects for commodity-specific promotional efforts, and consequently, our third hypothesis is rejected. We do estimate a statistically significant treatment effect for potatoes, but it is not significantly different from the control treatment.[4] However, commodity-specific advertising for apples and potatoes does lead to a relatively sharp increase in the dispersion of valuations. The coefficient on the dispersion of valuations in the treatment with apple advertising is 0.5760, and is 0.5360 for the treatment with potato advertising; both of these estimated coefficients are statistically higher than 0.3857, the estimated coefficient in the control treatment. Furthermore, relative to commodity-specific advertising, the dispersion of valuations with broad-based advertising is statistically lower than with either apple-specific advertising (t-ratio = 8.443) or potato specific advertising (t-ratio = 7.060). This result is consistent with an interpretation that the marginal consumer lies above the mean of the distribution of WTP bids, and a clockwise rotation of the demand curve causes the WTP for all consumers above the mean to fall.

Our treatment that combines commodity-specific advertising for potatoes and broad-based advertising appears to generate results that are closer to the broad-based results than those

from the commodity-specific treatments. The dispersion of valuations for the mixed treatment is lower than the control group and the difference is statistically significant. This finding is consistent with our second hypothesis for broad-based advertising and suggests that the broad-based component of the combined promotional effort is stronger. In terms of the shift effect, the average WTP for the treatment with potato advertising coupled with broad-based advertising is $0.16 higher than the control group, and this difference in WTP is statistically significant at the 1% level.

Several of the demographic and attitudinal variables also had a significant impact on WTP to fruits and vegetables in our experiment. In Table 2 we see that age, education, being the primary food shopper, knowledge of the 5 A Day Program, and being a consumer that purchases some conventional food products have positive effects on WTP for fruits and vegetables. Males, Asian subjects, and the self-reported number of vegetable servings consumed per day have negative effects on WTP. A negative coefficient on the self-reported number of vegetable servings per day is somewhat counter-intuitive; however, it may be the case that our experiment reminded subjects about the importance consuming vegetables and those with low intake levels responded with higher WTP bids. Lastly, we find that the quality of the apple advertisements, measured using a Likert Scale, has a positive and statistically significant effect on subjects' WTP for fruits and vegetables. The estimated coefficient for the Body Mass Index (BMI) variable is positive but not significant, and here we expected to see a negative relationship. The descriptive statistics in Table 1 indicate that our sample is comprised of approximately 71% women and the average BMI score was approximately 26, which is reflective of individuals of normal weight[5]. Therefore the composition of our sample may be contributing to this result for the BMI variable.

There was some concern when carrying out the experiment that a small number of the respondents submitted very low bids in all auctions and did not reveal their true demand for the selected fruits and vegetables. Table 1 shows that this sub-group included no more than three subjects per treatment, and twelve subjects across all treatments. We expect that this sub-group of subjects did not want to have binding bids for any of the auctioned items and used this approach to ensure that they would receive the full participation endowment. Consequently, we estimated a restricted model on a sub-sample of data wherein all bidders with an average bid (across all eight products) of $0.10 or less were removed from the data.

Table 3 presents the results from estimating constant parameter Tobit and random parameter Tobit models, and here we only included data from subjects with an average bid greater than $0.10. By comparing the goodness-of-fit statistics and individual parameter estimates, we find evidence that a few subjects were "gaming the experiment". In general, excluding those subjects with average bids below $0.10 does not change the qualitative nature of our conclusions, and only serves to sharpen the estimates of the mean treatment effects and dispersion of valuation effects for both broad-based advertising and commodity-specific advertising. The mean effect for the broad-based treatment is $0.28 higher than the control treatment in Table 3; the mean WTP increased by $0.10 in the treatment that combined apple and broad-based advertising, and by $0.30 in the treatment that included potato and broad-based advertising. In terms of goodness of fit, the log-likelihood function value in this case again supports the random coefficient model, and supports excluding the potentially troublesome bids.

Conclusion

Many fruit and vegetable producers in the United States contribute to commodity-specific promotional campaigns via mandatory checkoff programs. Broad-based promotional campaigns for fruits and vegetables have had wide media exposure in other developed countries; however,

the U.S. *5 A Day for Better Health* program, now called *Fruit and Veggies – More Matters*, has had a relatively small presence. Recently there has been a renewed interest in expanding these broad-based promotional efforts in the United States and discussions about introducing a mandatory checkoff program. This is an important issue for stakeholders in the fresh produce industry, as well as public policy units that aim to increase consumption of healthy food choices. Furthermore, there are surprisingly no other studies in the agricultural economics literature that have compared the implications of these two approaches for promoting fruits and vegetables.

Previous econometric studies using time series data suggest that commodity-specific programs are effective at increasing demand and yield net benefits to producers, and in some cases are underfunded. Our results show that such programs may be less effective at increasing demand for fruits and vegetables than earlier studies have suggested; we do not find that the commodity-specific programs included in our study resulted in an upwards shift in the demand for fruits and vegetables. However, commodity-specific campaigns do appear to have a significant clockwise rotational effect on the demand for fruits and vegetables. This result indicates that commodity-specific promotional campaigns lead to an increase in the dispersion of valuations, and that these programs are informative and increase the WTP among marginal consumers for specific products.

Results from our experiment indicate that, unlike commodity-specific promotional efforts, broad-based advertising does have a direct effect on the WTP for fruits and vegetables and therefore leads to an upward shift in demand. Furthermore, we find evidence that broad-based advertising also appears to have a counter-clockwise rotational effect on the demand for fruits and vegetables. After controlling for various demographic differences between treatments, average WTP across the eight fruits and vegetables was 41% higher among subjects in the broad-

based group compared to the control group, and the difference was statistically significant at the 1% level. For policy makers interested in food intake, obesity, and changing dietary habits, this result suggests that using additional resources for a broad-based promotional program may be an effective way to increase consumption of fruits and vegetables.

Our findings provide empirical support for the proponents of a broad-based promotional campaign who argue that such advertising would raise overall demand for fruits and vegetables. In taking a more holistic view of the entire fruit and vegetable industry, using commodity-specific advertising without a broad-based program is not an effective strategy for raising overall demand in the fresh produce category. Indeed, the fruit and vegetable industry may be better off without any commodity-specific advertising. Our treatment that combines potato advertising and a broad-based campaign provides evidence that a mixed advertising strategy may lead to a significant increase in the average WTP for fruits and vegetables. However, the increase in demand associated with this mixed strategy is very similar to the shift in demand associated with adoption of a broad-based program. Findings here show that combining potato-specific advertising with a broad-based campaign would result in only a slightly positive marginal change in the demand for fruits and vegetables. In the event that a mandatory broad-based program is implemented, individual commodity organizations would then need to carefully evaluate the marginal benefits and costs of adopting (or maintaining) a commodity-specific campaign. Further, we find that broad-based produce advertising can be effective in increasing valuations, but only if it reduces the dispersion of valuations. How might this be accomplished? If the produce industry were to mount advertisements that emphasize the common benefits of consuming fruits and vegetables, relative to fat- and salt-laden junk foods, for example, instead

of focusing on commodity-specific attributes, then preferences may become less disperse. In fact, this is precisely the intent of the broad-based advertisements used in our experiment.

Table 1. Means and Standard Deviations of Variables by Treatment

	Treatment					
	Control	**Broad Based Ads**	**Apple Ads**	**BB & Apple Ads**	**Potato Ads**	**BB & Potato Ads**
WTP	0.741	0.836	0.692	0.832	0.740	0.814
	(0.685)	(0.691)	(0.700)	(0.608)	(0.720)	(0.675)
Age	42.948	42.634	40.841	37.132	39.857	36.146
	(9.485)	(12.125)	(11.958)	(12.881)	(11.746)	(13.903)
Male	0.241	0.195	0.341	0.395	0.238	0.354
	(0.428)	(0.397)	(0.475)	(0.490)	(0.427)	(0.479)
Caucasian	0.862	0.878	0.818	0.737	0.714	0.729
	(0.345)	(0.328)	(0.386)	(0.441)	(0.452)	(0.445)
African	0.017	0.000	0.000	0.132	0.000	0.083
	(0.130)	(0.000)	(0.000)	(0.339)	(0.000)	(0.277)
Asian	0.086	0.073	0.159	0.079	0.167	0.083
	(0.281)	(0.261)	(0.366)	(0.270)	(0.373)	(0.277)
Education	2.776	2.805	3.045	2.658	3.095	2.583
	(1.191)	(1.111)	(1.244)	(1.200)	(1.132)	(1.153)
BMI	28.438	26.436	26.269	26.198	25.755	26.568
	(6.909)	(5.013)	(5.365)	(4.986)	(3.932)	(5.796)
Children	0.362	0.439	0.386	0.211	0.238	0.229
	(0.481)	(0.497)	(0.488)	(0.408)	(0.427)	(0.421)
Primary Shopper	0.793	0.902	0.841	0.711	0.810	0.854
	(0.406)	(0.297)	(0.366)	(0.454)	(0.393)	(0.353)
Income	2.207	2.220	2.091	1.789	2.000	1.688
	(0.906)	(0.926)	(0.794)	(0.801)	(0.874)	(1.065)
Number of Fruit Servings	2.138	2.073	2.227	2.316	2.238	2.563
	(1.153)	(0.868)	(0.823)	(1.240)	(1.813)	(1.621)
Number of Vegetable Servings	3.310	2.683	2.955	2.605	2.810	3.021
	(3.419)	(1.200)	(1.707)	(1.331)	(1.710)	(1.679)
5 A Day	0.690	0.878	0.659	0.579	0.762	0.792
	(0.463)	(0.328)	(0.475)	(0.495)	(0.427)	(0.407)
Vegetarian	0.017	0.049	0.068	0.053	0.024	0.125
	(0.130)	(0.216)	(0.252)	(0.224)	(0.153)	(0.331)
Conventional	0.931	0.927	0.977	0.895	0.976	0.938
	(0.254)	(0.261)	(0.149)	(0.307)	(0.153)	(0.242)
Quality of Apple Ads	N.A.	N.A.	3.705	3.278	N.A.	N.A.
	N.A.	N.A.	(0.869)	(1.240)	N.A.	N.A.
Quality of Potato Ads	N.A.	N.A.	N.A.	N.A.	2.810	2.625
	N.A.	N.A.	N.A.	N.A.	(1.141)	(1.014)
Quality of Broad Based Ads	N.A.	3.902	N.A.	3.278	N.A.	3.500
	N.A.	(1.009)	N.A.	(1.382)	N.A.	(1.119)
# subjects	58	41	44	38	42	48
# bids	464	328	352	304	336	384
% of zero bids	15.52%	12.20%	21.88%	8.55%	20.24%	15.63%
# subjects with avg WTP<0.10	2	3	3	1	1	2

Table 2. Tobit Model Estimates: Broad-Based and Commodity Specific Advertising

	Constant Parameter		Random Parameter	
	Estimate	**t-ratio**	**Estimate**	**t-ratio**
		Means of Random Parameters		
Control	0.3035*	1.874	0.3123**	2.250
Broad Based Ads	0.4152**	2.300	0.4403***	2.899
Commodity Specific: Apples	-0.0791	-0.391	-0.1115	-0.623
Combination: BB/Apples	0.2172	1.100	0.2135	1.247
Commodity Specific: Potatoes	0.2951*	1.857	0.2948**	2.163
Combination: BB/Potatoes	0.4478**	2.558	0.4729***	3.153
		Standard Deviations of Random Parameters		
Control	N.A.	N.A.	0.3857***	14.594
Broad Based Ads	N.A.	N.A.	0.3070***	9.884
Commodity Specific: Apples	N.A.	N.A.	0.5760***	17.640
Combination: BB/Apples	N.A.	N.A.	0.0299	0.847
Commodity Specific: Potatoes	N.A.	N.A.	0.5360***	15.878
Combination: BB/Potatoes	N.A.	N.A.	0.2986***	10.226
		Demographic Controls		
Age	0.0025*	1.685	0.0030**	2.351
Male	-0.0815**	-2.113	-0.0799**	-2.403
White	0.0509	0.754	0.048	0.914
African	0.0785	0.732	0.0834	0.994
Asian	-0.1573*	-1.816	-0.1959***	-2.681
Education	0.0397***	2.619	0.0406***	3.130
BMI	0.0041	1.326	0.0034	1.224
Children	0.0196	0.549	0.0095	0.306
Primary Shopper	0.0549	1.262	0.0639*	1.684
Income	0.0091	0.462	0.0081	0.492
Number of Fruit Servings	0.0098	0.745	0.0123	1.057
Number of Vegetable Servings	-0.0152**	-1.786	-0.0163**	-2.204
5 A Day	0.1563***	3.874	0.1538***	4.399
Vegetarian	-0.0443	-0.587	-0.0737	-1.044
Conventional	0.2005***	2.879	0.1816**	2.860
Quality of Apple Ads	0.0874***	2.985	0.0950***	3.897
Quality of Potato Ads	-0.0251	-0.751	-0.0294	-0.885
Quality of Broad Based Ads	-0.0110	-0.503	-0.0135	-0.741
σ^2	0.715	58.270	0.6007	66.504
Log-Likelihood Function	-2329.413		-2310.26	

Note: A single asterisk denotes significance at the 10% level, a double asterisk at the 5% level, and a triple asterisk at the 1% level.

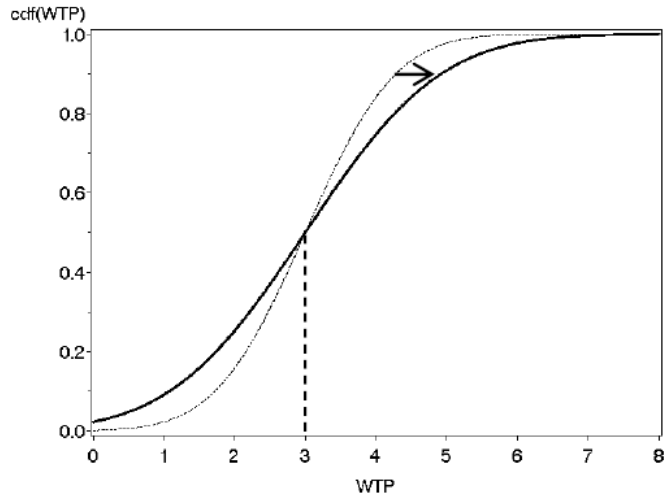
Table 3. Tobit Model Estimates Including Subjects with Average Bids Above $0.10

	Constant Parameter		Random Parameter	
	Estimate	**t-ratio**	**Estimate**	**t-ratio**
	Means of Random Parameters			
Control	0.3394**	2.107	0.3200**	2.240
Broad Based Ads	0.6106***	3.378	0.6019***	3.806
Commodity Specific: Apples	0.089	0.442	0.0441	0.237
Combination: BB/Apples	0.4468**	2.260	0.4175**	2.294
Commodity Specific: Potatoes	0.3275**	2.066	0.2924**	2.073
Combination: BB/Potatoes	0.6259***	3.598	0.6173***	4.010
	Standard Deviations of Random Parameters			
Control	N.A.	N.A.	0.3703***	14.077
Broad Based Ads	N.A.	N.A.	0.2557***	8.327
Commodity Specific: Apples	N.A.	N.A.	0.4837***	15.396
Combination: BB/Apples	N.A.	N.A.	0.0221	0.627
Commodity Specific: Potatoes	N.A.	N.A.	0.5475***	16.305
Combination: BB/Potatoes	N.A.	N.A.	0.2483***	8.358
	Demographic Controls			
Age	0.0019	1.355	0.0027**	2.153
Male	-0.1160***	-3.026	-0.1082***	-3.215
White	-0.0597	-0.875	-0.0726	-1.285
African	-0.0296	-0.280	-0.0338	-0.403
Asian	-0.2150**	-2.416	-0.2313***	-2.920
Education	0.0378**	2.485	0.0383***	2.852
BMI	0.0067**	2.225	0.0070**	2.447
Children	0.0478	1.359	0.0458	1.433
Primary Shopper	0.0562	1.309	0.0700*	1.791
Income	0.0441**	2.280	0.0369**	2.200
Number of Fruit Servings	0.0041	0.317	0.0057	0.498
Number of Vegetable Servings	0.0067	0.644	0.0058**	0.645
5 A Day	0.1013**	2.479	0.1092***	2.987
Vegetarian	-0.0262	-0.349	-0.0524	-0.721
Conventional	0.1626**	2.338	0.1430**	2.090
Quality of Apple Ads	0.0684**	2.323	0.0741***	2.837
Quality of Potato Ads	-0.0236	-0.724	-0.0301	-0.909
Quality of Broad Based Ads	-0.0383*	-1.793	-0.0395**	-2.200
σ^2	0.6895	58.192	0.5904	67.421
Log-Likelihood Function	-2169.138		-2155.72	

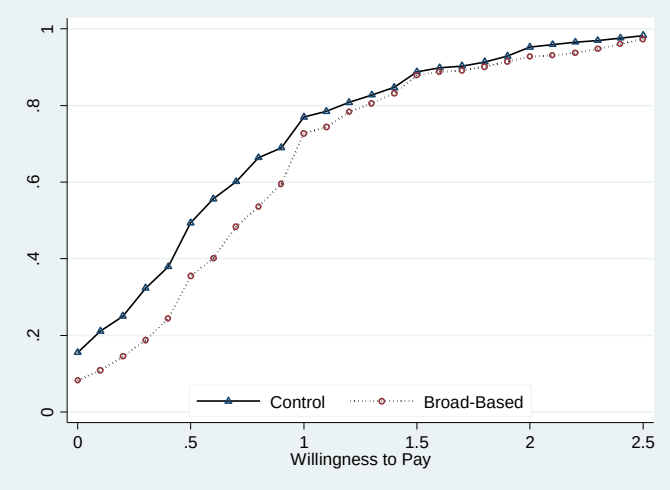
Note: A single asterisk denotes significance at the 10% level, a double asterisk at the 5% level, and a triple asterisk at the 1% level.

Figure 1. Cumulative Distributions of Consumer Valuations

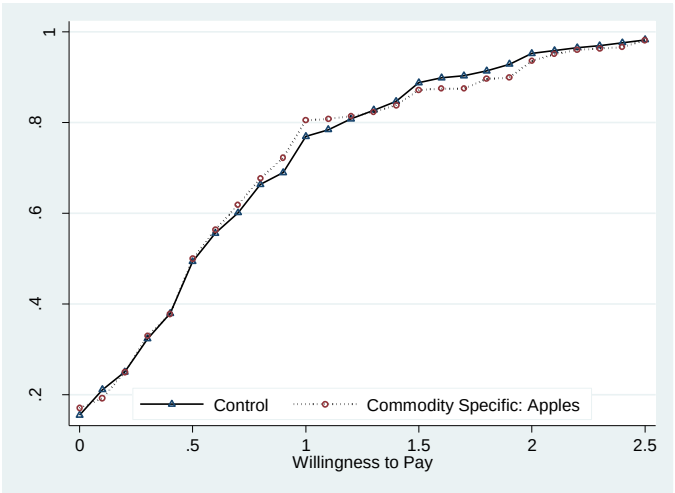
(a) Sample Rotation of CDF with increased dispersion



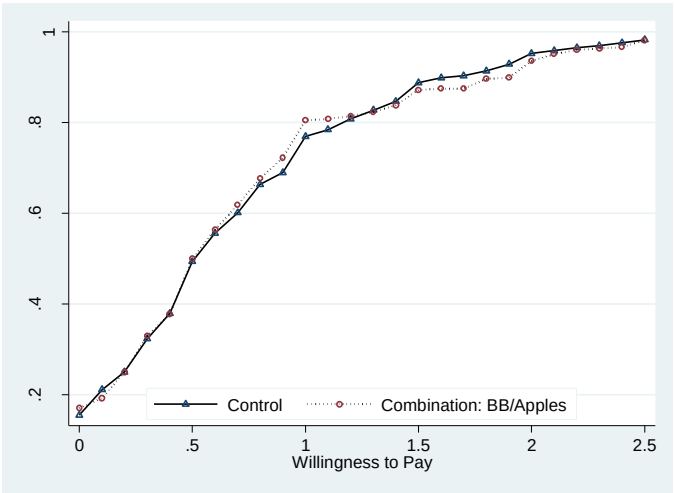
(b) Control vs. Broad-Based



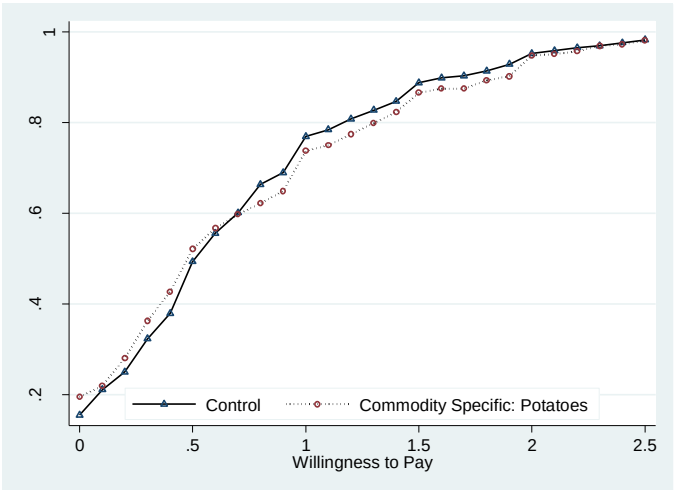
(c) Control vs. Commodity Specific: Apples



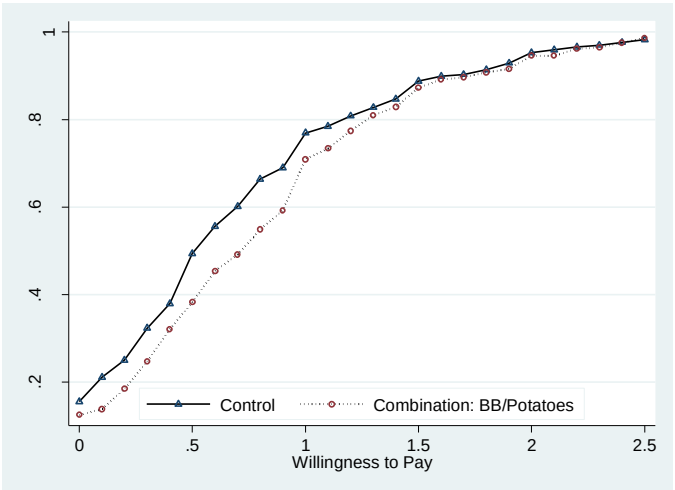
(d) Control vs. Combination: BB/Apples



(e) Control vs. Commodity Specific: Potatoes



(f) Control vs. Combination: BB/Potatoes



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Endnotes

[1] The Produce for Better Health Foundation (PBH) is a non-profit program with the objective of raising awareness and consumption levels of fruits and vegetables.

[2] The titles of the three 90-second episodes are: "Family Therapy", "Echo Canyon" and "Punching Bag". These episodes were originally contained as segments of *The Tracey Ullman Show*. All media files are available at: http://www.simpsoncrazy.com/ullman-shorts

[3] Item-specific WTP estimates are not shown in Tables 2 and 3, but are available from the authors upon request. Demographic variables are defined as follows: Male = 1 if respondent is a male; Caucasian = 1 if respondent is caucasian; African = 1 if respondent is African; Asian = 1 if respondent is Asian; Education is coded as 1 = high school, 2 = associates degree, 3 = bachelors degree, 4 = masters degree, and 5 = doctorate; Body Mass Index (BMI) is measured as (weight in kg / (height in cm)^2); Children = 1 if respondent has children < 18 yrs. of age at home; Primary Shopper = 1 if the respondent is the primary shopper; Income: 1= < $40K, 2 = $40K-80K, 3 = $80K-$120K, 4 = $120K-$160K, and 5 > $160K; Number of Fruit Servings is the number of fruit servings typically consumed per day; Number of Vegetable Servings is the number of vegetable servings typically consumed per day; 5 A Day = if the respondent is aware of the 5 A Day campaign; Vegetarian = 1 if the respondent is a vegetarian or vegan; Conventional = 1 if the respondent buys some conventionally-grown (not organic) produce; Apple Ads, Potato Ads and Broad Based Ads are Likert Scale questions 1 (hate) to 5 (love) each of the advertisements shown in the experiment.

[4] Results from a model that only included bids for apples and potatoes also do not show a statistically significant direct effect for the commodity-specific treatments. These econometric results are not included in the paper but are available from the authors.

[5] Body Mass Index (BMI) is a measure of a person's weight in relation to height, not body composition. BMI values apply to both men and women, regardless of age or frame size. A BMI score between 20 and 25 is considered ideal. A score below 18.5 indicates underweight while a score between 25 and 29 indicates overweight. Experts consider a score of 30 or higher an indicator of obesity.

Appendix A: Survey Questions for Fruit and Vegetable Experiment

1. What is your age? _____
2. Are you male ____ female _____?
3. What race are you? ____ Caucasian ____ African American ___ Asian ___ Hispanic ____ Native American ___ Other
4. What is the highest attainable education level you achieved? __ High School __ Associates Degree __ College Degree __ Masters Degree __ Doctorate
5. What is your weight in pounds? ____
6. What is your height in feet and inches (e.g., 5' 9")? _____
7. Do you have children under 18 years old living at home? Yes____ No _____
8. Are you the primary food shopper in your family? Yes ____ No ____
9. Approximately how many fruits do you eat per day? ____
10. Approximately how many vegetables do you eat per day? ___
11. Have you heard of the "5-A-Day" campaign? Yes ____ No ____
12. Are you a vegetarian or Vegan? Yes ____ No ____
13. Do you buy conventional (non-organic) fruits and vegetables? Yes ___ No ____
14. What is your household income level? ____ less than $40,000 ___ $40,000-$80,000 ____ $80,000 - $120,000 ___ $120,000-$160,000 ___ over $160,000

For questions 15-22: On a scale of 1 (hate) to 5 (love), please rank how much you like:

15. Tomatoes ___
16. Potatoes ___
17. Carrots ___
18. Peppers ___
19. Apples___
20. Bananas ___
21. Grapes ___
22. Oranges ___
23. On a scale of 1 (hate) to 5 (love), please rank how much you liked the apple advertisements ___
24. On a scale of 1 (hate) to 5 (love), please rank how much you liked the potato advertisements ___
25. On a scale of 1 (hate) to 5 (love), please rank how much you liked the "fruit and vegetable" advertisements ___

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