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# Consumer preferences for organic production methods and origin promotions on ornamental plants: evidence from eye-tracking experiments

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**Abstract**

The strategic value of organic production and origin promotions may vary based on product end-use. Conjoint analysis and eye-tracking technology were used to investigate consumers' purchase likelihood (PL) and visual search behavior for esthetic and food-producing ornamental plants. Organic production methods, in-state, and domestic origins positively impacted participants' PL. Respondents' visual attention to the organic production attribute had a strong positive effect on PL for food-producing plants as did sociodemographic variables. Findings imply that producers and retailers could successfully implement signage emphasizing organic production methods and origin designations to generate consumer interest.

*JEL classifications*: M31, Q13

*Keywords:* Choice modeling; Conjoint analysis; Nursery production; Ordered logit model; State promotional programs

## 1. Introduction

Ornamental horticulture products are important to the U.S. economy. In 2007, the U.S. nursery and greenhouse industry contributed $175.3 billion dollars in revenue and employed nearly 2 million employees (Hodges et al., 2011). In 2013, indoor foliage plants were valued at $778 million (wholesale value) (USDA-NASS, 2014); while in 2006, fruit and nut plants were valued at $276.4 million (wholesale value) (USDA-NASS, 2006). Although economically important, U.S. consumer demand for ornamental plants was negatively impacted by the economic recession resulting in decreased demand and lower profit margins (Brumfield, 2010). One strategy to stimulate demand is to promote nontraditional, novel plant attributes (i.e., organic production methods and origins) to generate consumer interest (Hall and Dickson, 2011; Rihn et al., 2015; Schimmenti et al., 2013; Yue et al., 2011). However, plants require substantial time to grow to salable size and producing plants with these attributes can be costly (Cáceres, 2005); hence, studying consumer preferences can reduce industry stakeholders' risks (i.e., time, labor, production space, marketing, and financial investments) through assessing consumers' interest prior to implementation.

Historically, consumer preference studies for ornamental plants have concentrated on esthetic characteristics (Kelley et al., 2001). More recently, consumer interest in local and ecofriendly products has motivated researchers to explore value-added traits that are independent of the plant's physical appearance (Collart et al., 2013; Hall and Dickson, 2011; Yue et al., 2011). However, many of these are credence attributes meaning they are not readily apparent in most retail settings, which is problematic since consumers do not differentiate between similar plants due to low or no esthetic differences (Hall and Dickson, 2011).

Utilizing in-store promotions is one means of differentiating products and justifying higher price points. In-store promotions increase consumers' perceived value through touting nontraditional attributes (Hall and Dickson, 2011). Knowing which in-store promotions are effective and which are not is important because effective in-store displays can improve sales (Nordfält, 2011). However, Collart et al. (2013) caution that in-store plant promotions are insufficient to increase consumer brand awareness, potentially due to excessive visual clutter.

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**Data Appendix Available Online**

A data appendix to replicate main results is available in the online version of this article.



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This ineffectiveness is a concern because a substantial amount of money (e.g., the food industry spent $48.7 billion in 1997) is spent on developing in-store promotions (Elitzak, 1999). Consequently, it is invaluable to evaluate consumers' use of in-store promotions to improve their effectiveness.

Organic production methods and product origins are two novel attributes of interest due to increasing consumer demand. In 2011, U.S. organic industry sales increased 9.5% over the previous year to $31.5 billion with the majority (93%) of sales being attributed to edible products (Haumann, 2012). Some individuals prefer organic products because of environmental concerns or due to perceptions of improved quality, safety, health, and nutrition or less pesticide residue (Campbell et al., 2013; Costanigro et al., 2011; Smed, 2012). However, the increased costs associated with certified organic production are a shortcoming (Uematsu and Mishra, 2012) since higher prices can be a major purchasing deterrent (Magnusson et al., 2001). One solution is to selectively implement organic production practices and promote the products as *grown using organic methods*, rather than being certified organic. Thus, providing producers with the advantage of promoting plants produced using organic methods at a reduced cost (Cáceres, 2005). Some of those savings can then be passed on to the consumer, meanwhile contributing to the producer welfare by increasing demand for organically grown (as opposed to certified organic) (Bernard et al., 2013; Cáceres, 2005). Organic production gives the consumer more value with a less expensive but more sustainable option because organic production methods are perceived as being more sustainable than conventional production methods (Campbell et al., 2013; Campbell et al., 2015). However, consumers assume some risk with organic production methods due to lack of regulations (Campbell et al., 2015). Supporting evidence indicates that consumers are interested in other sustainable production practices besides "certified organic" (Hawkins et al., 2012). Consumer preference studies on organic production have focused on food products due to personal health associations (Campbell et al., 2013). Research on consumer preferences for organic plants is less common (Schimmenti et al., 2013; Yue et al., 2011).

Regarding product origins, in 2008, consumer demand for regional and local foods was $4.8 billion and accounted for 1.6% of all U.S. agricultural products (Johnson et al., 2013). Between 1994 and 2014, the number of farmers markets in the United States (which primarily sell regional/local products) grew nearly 800% nationwide (USDA-AMS, 2014). Increased demand comes from perceptions of local/domestic products being higher quality, safer, more environmentally friendly, and economically beneficial to local/domestic markets (Costanigro et al., 2011; Xie et al., 2016). Additionally, federal law requires country of origin labels on fresh produce (USDA-AMS, 2012), which has stimulated studies on consumer preferences for foods from different origins (Bienenfeld et al., 2016; Ehmke et al., 2008). Studies investigating ornamental plant origins are more limited and often focus on state promotional campaigns. State promotion programs have been shown to improve plant sales by 81% (Anella et al., 2001) and increase consumer willingness-to-pay (WTP) by 10% (Collart et al., 2013). State promotion programs have successfully increased ornamental plant sales in Oklahoma (Anella et al., 2001) and Pennsylvania (Wehry et al., 2007).

Despite increased demand, previous research provides mixed conclusions on consumers' preferences and willingness to pay for production method and origin attributes on plants. For example, Yue et al. (2011) found low U.S. consumer interest in organic production and high consumer interest in locally grown ornamental, vegetable, and herb transplants. Conversely, Hawkins et al. (2012) determined consumers were interested in and willing to pay 10% more for organic ornamental, vegetable, and herb plants, while consumers were less interested in local origins. Schimmenti et al. (2013) suggested that a niche market exists for organically produced plants due to their limited availability.

Considering the limited studies and mixed conclusions, the main purpose of the present study was to investigate the effects of organic production methods and origin designations on consumers' purchase likelihood (PL) for indoor foliage and fruit-producing plants. Since consumer interest in organic plants can be related to factors other than personal health/consumption (e.g., concerns for the environment), the present study investigated whether individuals preferred organically grown ornamental plants over conventionally grown alternatives. Individuals' preferences for locally or domestically grown versus imported ornamental plants were also examined. A secondary goal was to evaluate the effects of visual attention to in-store promotions on consumer PL for plants with different end-uses. To reach our goals, conjoint analysis experiments were administered to plant consumers in Florida. While consumers rated their PL in the conjoint analysis, their eye movements were recorded to provide additional insights on use of in-store promotions. Incorporating visual attention data provided the opportunity to evaluate how much visual consideration consumers gave to each attribute and how that affected their responses. In turn, this facilitated our understanding of the effects of organic or origin promotions on consumers' preferences. Plants pose a unique opportunity to investigate the impact of organic production methods and origins on consumer preferences for *esthetic* and *food-producing* products. Supporting evidence suggests using these attributes to differentiate horticulture products and attract consumers (Hall and Dickson, 2011; Schimmenti et al., 2013; Yue et al., 2011). However, the importance individuals assign to production methods and origins may vary by end-use (Schimmenti et al., 2013; Yue et al., 2011).

## 2. The role of visual attention

A relatively new and conceptually relevant addition to the choice analysis framework is visual attention data. Balcombe et al. (2013) state "eye-tracking provides one of the most powerful means by which the processes driving individuals' choices can be uncovered." Eye-tracking metrics provide the benefits of insights into consumer behavior, a concise attribute attendance measurement, and improved econometric model fit (Balcombe et al., 2013; Van Loo et al., 2015). Visual attention has also been connected to consumers' decision-making processes (Arieli et al., 2011; Russo and Leclerc, 1994) and choices (Balcombe et al., 2013; Reutskaja et al., 2011).

Accurately measuring visual attention is important because only a small amount of visual stimuli are used to make decisions. Eighty-three percent of the information humans use is visually gathered (Wästlund et al., 2010); however, only 2% of the visual field is actually processed and influences behavior (Balcombe et al., 2013). Bundesen's (1990) theory of visual attention proposes that visual stimuli is filtered, sorted, and stored in short-term memory where it can be used as needed in the decision-making process. Similarly, Balcombe et al. (2013) found that consumers are highly selective of the information they view. Consequently, a limited amount of visual stimuli is processed and affects consumers' decisions. Russo and Leclerc (1994) went further and used visual attention to identify three decision-making stages: 1) orientation (where information acquisition occurs), 2) product evaluation, and 3) refixation, choice, and verification. The greatest visual consideration occurs during the evaluation stage. Specifically, visual stimuli that require additional consideration (i.e., cognitive effort during evaluation) obtain greater visual attendance than visual stimuli requiring less effort (Russo and Leclerc, 1994). Often additional visual consideration is required for unfamiliar, novel, complex, or important stimuli (Aribarg et al., 2010; Arieli et al., 2011; Rihn et al., 2015; Russo and Leclerc, 1994).

Although visual attention's effect on consumer decisions has been studied, research utilizing eye-tracking technology to investigate the relationship between consideration of in-store visual stimuli (i.e., bottom-up factors) and consumer preferences is scarce (Wedel and Pieters, 2008). Behe et al. (2014) used eye-tracking technology with conjoint analysis and determined consumers spend more time visually considering important plant attributes (consistent with Russo and Leclerc, 1994). Furthermore, Behe et al. (2013) found that greater visual consideration of plants increases consumers' PL. Both Behe et al. (2013) and Behe et al. (2014) demonstrate a correlation between visual consideration and consumers' choice behavior. Thus, eye-tracking technology was used in the present study to assess the use of in-store stimuli by consumers.

## 3. Hypotheses

Four hypotheses were tested. First, based on increasing demand for organic products (Haumann, 2012) and consumers' interest in organic plants (Schimmenti et al., 2013), we hypothesize that consumers prefer plants grown using organic production practices (as opposed to conventional practices; H1). Second, since demand for local products has grown (Johnson et al., 2013; Yue et al., 2011), consumers will be more likely to purchase plants grown in-state or grown in another state (i.e., domestic) than imported plants (H2). Third, visual consideration of organic production methods positively influences PL for all plant types (H3). Lastly, visual consideration of in-state and domestic origin designations positively affects consumers' PL for both plant types (H4). The third and fourth hypotheses are based on expanding consumer interest (Haumann, 2012; Johnson et al., 2013) and that the attributes may require additional visual consideration and processing when determining PL (Aribarg et al., 2010; Benini et al., 2005).

Table 1
Ornamental plant attributes and attribute levels

| Attributes | Attribute levels | |
|---|---|---|
| Plant type† | Fruit-producing plants | Indoor foliage plants |
| Price† | \$15.98 | \$10.98 |
| | \$17.98 | \$12.98 |
| | \$19.98 | \$14.98 |
| Production method | Certified organic | Certified organic |
| | Organic production | Organic production |
| | Not organic | Not organic |
| Origin‡ | In-state (Fresh from Florida) | In-state (Fresh from Florida) |
| | Domestic (grown in United States) | Domestic (grown in United States) |
| | Import (grown outside United States) | Import (grown outside United States) |
| VOC removal§ | – | High (>50%) |
| | | Low (<50%) |
| | | Not rated |

†Plant type and price points were determined based on retail observations in Florida (i.e., mass retailers and garden centers).
‡The Florida Department of Agriculture and Consumer Services' *Fresh from Florida* logo was used to indicate in-state origins.
§VOC removal was only provided for the indoor foliage plants. Levels were based on Liu et al. (2007).

## 4. Methodology

### 4.1. Experiment design

An ornamental plant-rating-based conjoint analysis experiment was used in conjunction with eye-tracking technology and a follow-up questionnaire to analyze participants' preferences for ornamental plants with different production practices, origins, and end-uses. Rating-based conjoint analysis and eye-tracking technology were utilized because this method has been successfully used to measure consumer likelihood to buy ornamental plants (Behe et al., 2013; Behe et al., 2014). Furthermore, rating-based conjoint analysis exhibits similar results to choice-based models in terms of prominence effect, compatibility effect, and validity (Elrod et al., 1992; Moore et al., 1998; Moore, 2004).

The experiment included two broad plant categories (indoor foliage plants and fruit-producing plants). The scenario attributes included price, production method, and origin (Table 1). Price points were averaged from retail observations at three mass retailers and three independent garden centers in Florida. Production methods included certified organic, organic production, and not organic. Origin attributes included in-state, domestic, and imported plants. Additionally, a volatile organic compound (VOC) removal attribute was included in the indoor foliage plant scenarios since it has been considered as a value-added promotional strategy for indoor foliage plants (Hall and Dickson, 2011; Solano, 2012). All of the attribute definitions were provided to participants prior to the experiment (online appendix).

Attribute and attribute levels resulted in 81 ($3^4$) possible scenarios for indoor foliage plants and 27 ($3^3$) possible scenarios for fruit-producing plants. To reduce participant fatigue and maintain data quality (Keller and Staelin, 1987; McDaniel and Gates, 2010), SPSS software was used to generate a fractional factorial design with 16 indoor foliage plant and 9 fruit-producing plant scenarios. Scenarios were sorted by plant type and each participant was randomly assigned to evaluate either indoor foliage or fruit-producing plants. A total of 95 participants rated the fruit-producing plants and 91 participants assessed the indoor foliage plants. Although sample self-selection bias was a possibility, the sample demographics align with U.S. plant purchaser demographics (National Gardening Association, 2009) and the bivariate results are robust for the production methods (Hawkins et al., 2012; Schimmenti et al., 2013) and origin attributes (Anella et al., 2001; Collart et al., 2013; Yue et al., 2011). Therefore, the sample was determined to be acceptable.

According to the procedures outlined in Behe et al. (2013), participants viewed images of the plants on a computer monitor (23 inches, 1,920 × 1,080 pixel resolution). Above-plant signs specified the indoor foliage plant attributes (Figure 1A, online appendix), while plant tags indicated fruit-producing plant attribute levels to accommodate the larger sized plants (Figure 2A, online appendix). To increase the visual consistency of the attributes, all attribute indicators had consistent font (color, size, style[1]). To eliminate any potential order impact, the attribute locations were randomized. While viewing the plant images, participants' eye movements were recorded using a Tobii X1 Light Eye Tracker (Tobii Technology, Stockhom, Sweden). The eye-tracking camera was mounted on the computer monitor and the scenario images were located centrally on the screen (Figure 3A, online appendix). After visually evaluating each scenario, participants rated their PL using a 7-point Likert scale (1 = very unlikely; 7 = very likely). At the end of the eye-tracking experiment, participants completed a separate computer-based questionnaire (collected using Qualtrics Online Survey Software) containing sociodemographic questions.

Newspaper advertisements, Craigslist listings, and printed fliers (distributed at garden centers, extension offices, and on community boards) were used to recruit participants in Florida, during June–July 2014. Participants were screened to insure that they had purchased plants within the past 12 months. Participants were compensated $30.

After the experiment, areas of interest (AOIs) were used to extract the visual attention data from the scenario images. AOIs are geometric shapes used to indicate the visual stimuli (i.e., plant image, attribute signs, total image, etc.) of interest (Figure 4A, online appendix). Once the AOIs are defined for each scenario, visual attention data can be extracted for analysis.

Total visit duration (TVD) metrics were used to measure participants' visual attention in the rating-based conjoint analysis. TVD is the total amount of time (in seconds) spent by individuals viewing each attribute. TVD has been found to be related to cognitive processing, decision making (Ares et al., 2013; Russo and Leclerc, 1994), attribute importance (Behe et al., 2014), attribute relevance to task (Ares et al., 2013), and attribute complexity (Arieli et al., 2011). TVD results can be interpreted as considered or instinctive responses. A more considered response (i.e., longer TVD) is required if the stimuli need additional cognitive effort, concentration, involvement, or is goal/task motivated (Benini et al., 2005; Russo and Leclerc, 1994). Conversely, instinctive responses are less salient, involuntary responses to stimuli (Benini et al., 2005). Hence, a more considered response would require more visual attention than an instinctive response due to increased cognitive processing (Russo and Leclerc, 1994). To account for differences in attribute length and layout, visual attention metric proportions were estimated for the data analysis. Specifically, TVD proportions (TVDPs) were estimated by dividing the TVD for each attribute by the TVD for the total image.[2] For example, to estimate the TVDP for certified organic, TVDP_certified organic = ($TVD_{\text{certified organic}}$ / $TVD_{\text{total image}}$).

### 4.2. Model description

The dependent variable was an ordinal PL rating score. However, with ordinal dependent variables, researchers cannot assume that the response categories are equal distances apart and have equal weights (Long and Freese, 2006). Ordinal logit regression models circumvent this assumption since they are nonlinear (Long and Freese, 2006). The ordered logit model was first introduced by McElevy and Zavoina (1975) who altered the ordered probit model so that the error component had a standard logistic distribution instead of a standard normal distribution. Consequently, the variable parameters are equal to the distance between the ordinal variables. Previous studies have successfully used ordered logit regression models (also known as the proportional odds model) to assess the impact of ordinal variables on consumers' stated preferences (Smith et al., 2009; Wang et al., 2010). Ordered logit models provide researchers the opportunity to "recognize variable ordinality, avoid arbitrary

[1] To eliminate color/font differences between the Fresh from Florida brand and other attribute signs, color codes and font types were obtained from the Marketing and Development Division at the Florida Department of Agriculture and Consumer Services (see Figures 1 and 2, online appendix).

[2] Total image AOI included the plant image, attribute signs, and white background (Figure 4, online appendix).

assumptions about their scale, and allow for analysis of continuous, dichotomous, and ordinal variables within a common statistical framework" (Winship and Mare, 1984). Furthermore, since the dependent variable is ordinal, multinomial logit and probit models cannot be used due to not accounting for the ordinal nature of the dependent variable (Greene, 1997). Thus, since the dependent variable was ordinal and discrete while the independent variables vary (dichotomous: plant type, production method, origin, price, VOC removal, gender, child, relationship, education; continuous: age, income, household, and TVDP), an ordered logit model was used to analyze the data.

Following Long and Freese (2006), the model is derived from a measurement model by mapping a latent variable $y^*$ ranging from $-\infty$ to $\infty$ to an observed variable $y$. Considering the $J$ number of categories in the ordinal measure, the relationship between observed and latent variable can be shown as

$$y_i = m \; if \; \kappa_{m-1} \leq y_i^* < \kappa_m \; for \; m = 1 \; to \; J, \tag{1}$$

where $\kappa$s are thresholds (or cutpoint boundaries for each $m$ category) in the distribution of $y^*$ that once crossed result in a category change. The extreme categories 1 and $J$ can be represented by the following open-ended intervals $\kappa_0 = -\infty$ and $\kappa_J = \infty$, which translated into our PL rating with seven categories (1 = very unlikely, ..., 7 = very likely) shown as:

$$y_i = \begin{cases} 1 & if \quad \kappa_0 = -\infty \leq y_i^* < \kappa_1 \\ 2 & if \quad \kappa_1 \leq y_i^* < \kappa_2 \\ \vdots & \vdots \quad \quad \vdots \\ 7 & if \quad \kappa_6 \leq y_i^* < \kappa_7 = \infty. \end{cases} \tag{2}$$

Based on the measurement model above, the structural model can be defined as

$$y_i^* = \mathbf{x}_i \beta + \varepsilon_i, \tag{3}$$

where $\mathbf{x}_i$ is a row vector of values for the $i$th observation, $\beta$ is a column vector of structural parameters to be estimated, and $\varepsilon$ is the random error term. To estimate the model using maximum likelihood (ML) method, a specific form of the error distribution must be assumed. Although other distributions were considered in previous research (e.g., McCullagh, 1980), for the ordered logit model, the $\varepsilon$ is conventionally assumed to have a logistic distribution with a mean of 0 and variance of $\pi^2/3$, with the following probability distribution $\lambda(\varepsilon) = \exp(\varepsilon)/[1 + \exp(\varepsilon)]^2$, and cumulative distribution $\Lambda(\varepsilon) = \exp(\varepsilon)/1 + \exp(\varepsilon)$ functions.

The assumption of the distribution of the error term allows relating probabilities of outcomes ($y$) given values of $\mathbf{x}$, as shown in the following equation (Long and Freese, 2006):

$$\text{Prob}\,(y_i = m|\mathbf{x}_i) = \text{Prob}\left(\kappa_{m-1} \leq y_i^* \langle \kappa_m | \, \mathbf{x}_i\right). \tag{4}$$

By substituting $\mathbf{x}_i \beta + \varepsilon_i$ for $y_i^*$ in Eq. (4) leads to the probability of any observed outcome $y_i = m$ given $\mathbf{x}_i$ to be generalized as the difference between cumulative distribution functions evaluated at any given $m$ values:

$$\text{Prob}\,(y_i = m|\mathbf{x}_i) = F\,(\kappa_m - \mathbf{x}_i \beta) - F\,(\kappa_{m-1} - \mathbf{x}_i \beta)\,, \tag{5}$$

where $F$ indicates the cumulative distribution function.

### 4.3. Model estimation

Given the formulation in Eq. (5), the probability of observed value of $y_i$ (i.e., PL rating) for the $i$th observation can be represented as:

$$p_i = \begin{cases} \text{Prob}\,(y_i = 1|\mathbf{x}_i, \beta, \; \kappa) \; if \; \; y = 1 \\ \vdots \\ \text{Prob}\,(y_i = m|\mathbf{x}_i, \beta, \; \kappa) \; if \; \; y = m \\ \vdots \\ \text{Prob}\,(y_i = 7|\mathbf{x}_i, \beta, \; \kappa) \; if \; \; y = 7 \end{cases}. \tag{6}$$

The likelihood equation can be represented as:

$$L(\beta, \; \kappa \, | \mathbf{y}, \; \mathbf{X}) = \prod_{i=1}^{N} p_i. \tag{7}$$

After multiplying over cases where $y$ is observed to equal $j$, and taking logs, the log likelihood function becomes (Long and Freese, 2006):

$$\ln L(\beta, \; \kappa \, | \mathbf{y}, \; \mathbf{X}) = \sum_{j=1}^{J} \sum_{y_i = J} \ln \left[ F\left(\kappa_m - \mathbf{x}_i \beta\right) - F\left(\kappa_{m-1} - \mathbf{x}_i \beta\right)\right] \tag{8}$$

The estimation was conducted using Stata SPost9 package of commands developed by Long and Freese (2006). The first ordered logit model analyzed the relationship between PL product- and individual-specific variables for indoor foliage plants, while the fruit-producing scenarios were analyzed in the second ordered logit model. Marginal effects were also estimated using the ordered logit model results to detect the difference in predicted probabilities for each attribute at different PL levels.

## 5. Results

A total usable sample of 186 was collected in Florida with the majority (76.4%) in the Orlando area and the remainder (23.6%) in Gainesville. Sociodemographic variables were not statistically different between indoor foliage plants and fruit-producing plants. Participants' average age was 47 years old with 55% being 45 years old and older (Table 2). Thirty-four percent of the participants were male and 66% were in a relationship/married. The average 2013 household income was \$51,789 with 46% earning more than \$50,000. The average

Table 2
Summary statistics of participants ($n = 186$)

| Variable | Description of variables | Sample Mean (S.E.) | Florida† Mean |
|---|---|---|---|
| *Age* | Age of participant | 46.598 (18.047) | 20.6% <18 years<br>18.7% >65 years |
| *Gender* | Gender of participant<br>(1 = male; 0 = female) | 0.342 (0.476) | 0.499 |
| *Income* | 2013 gross household income ($1,000) | 51.789 (34.146) | $47,309 |
| *Child* | Household includes a child less than 12 years old<br>(1 = yes; 0 = no) | 0.106 (0.308) | Not available |
| *Relationship* | Relationship status<br>(1 = in a relationship/married; 0 = not married/single, divorced/separated, widowed) | 0.656 (0.476) | Not available |
| *Household* | Household size | 2.262 (1.862) | 2.58 |
| *Education* | Highest level of education completed<br>1 = four-year college degree, some graduate school, and/or a graduate degree<br>0 = otherwise (i.e., some high school, high school diploma/GED, some college, and/or two-year associates degree) | 0.469 (0.500) | 26.2% had their Bachelor's degree or higher |

†Pairwise *t*-tests were used to determine significance between indoor foliage and fruit-producing plants. The sociodemographic variables were not significant; therefore, the total sample means are provided.
£United States Census Bureau (2014).

household size was 2.3 people. Forty-seven percent of participants had completed a four-year college degree at the time of the study. Eleven percent had a child less than 12 years old in their household. The sociodemographic results are consistent with the National Gardening Association's (2009) report. Although we cannot make statistical inferences, Florida census data are provided as a point of reference (Table 2). In general, our sample was comparable to the Florida census data with the exception of men being underrepresented, which is likely due to women being the core consumers of plants (National Gardening Association, 2009). Additionally, our sample had a slightly higher income and smaller household size than the Florida census data.

### *5.1. Preferences for indoor foliage plants*

Price, production method, origin, and VOC removal all affected participants' PL for indoor foliage plants (Table 3). Price negatively affected participants' PL, indicating that as price increased, the plants became less desirable. Certified organic and organic production positively affected participants' PL when compared to conventional production methods, supporting hypothesis 1, which is consistent with Hawkins et al. (2012) but counter to Yue et al. (2011). Regarding origin, in-state and domestic origins improved participants' PL when compared to imported origins, supporting hypothesis 2. The origin coefficient estimates are consistent with previous research (Anella et al., 2001; Xie et al., 2016; Yue et al., 2011; Wehry et al., 2007). High VOC removal increased PL when compared to no VOC removal that is consistent with Solano (2012). However, low VOC removal was negatively correlated with PL. Children in the household decreased PL. Age, gender, income, relationship status, household size, and education level did not influence PL.

The TVDP analyses provided additional insights about the relationship between considered (as indicated by longer TVDP) and instinctive (shorter TVDP) responses to the visual stimuli and consumers' PL. TVDP on the indoor foliage plant image (as represented by the *TVDP_plant* variable) increased participants' PL, indicating increased consideration of the plant itself resulted in a positive response from consumers (Table 3). This result is not surprising since plant quality is a primary purchasing attribute that is often determined based on the visual appearance of the plant (Kendal et al., 2012). Increased visual consideration (TVDP) of conventional production methods robustly reduced PL, while visual consideration of certified organic and organic production methods was insignificant. Overall, increased visual consideration of the conventional production sign resulted in an adverse response, meaning that the considered response was less positive than the instinctive one which partially supports hypothesis 3.

Regarding visual consideration of the origin signs, increased visual consideration of import positively impacted consumers' responses (Table 3). There was no difference between considered and instinctive responses for the in-state and domestic signs. Hypothesis 4 was not supported for indoor foliage plants. Participant familiarity with the in-state and domestic attributes may have reduced the visual consideration resulting in their lack of significance (Aribarg et al., 2010). TVDP for VOC removal was not significant.

Table 3
Indoor foliage plant ordered logit regression estimates ($n = 91$)

| Attribute variables | Coeff. (Std. Err.)£ |
|---|---|
| Price | −0.054 (0.023)* |
| Certified organic | 0.755 (0.106)*** |
| Organic production | 0.529 (0.105)*** |
| Conventional | Base |
| In-state | 1.053 (0.170)*** |
| Domestic | 0.693 (0.142)*** |
| Import | Base |
| High VOC removal | 0.747 (0.106)*** |
| Low VOC removal | −0.407 (0.096)*** |
| VOC removal—not rated | Base |
| Sociodemographic variables | |
| Age | −0.006 (0.009) |
| Gender | 0.103 (0.366) |
| Income | −0.001 (0.004) |
| Child | −0.992 (0.564)*** |
| Relationship | 0.210 (0.308) |
| Household | 0.002 (0.066) |
| Education | 0.169 (0.232) |
| Total visit duration proportion variables† | |
| TVDP_plant | 1.697 (0.890)* |
| TVDP_price | 3.267 (5.413) |
| TVDP_certified organic | 1.436 (1.147) |
| TVDP_organic production | 1.812 (1.019) |
| TVDP_conventional | −5.201 (2.602)* |
| TVDP_in-state | 1.941 (3.401) |
| TVDP_domestic | −4.365 (3.065) |
| TVDP_import | 4.093 (1.514)** |
| TVDP_VOC removal | 0.646 (2.669) |
| Threshold parameters | |
| 1 | −0.621 (0.997) |
| 2 | 0.147 (0.981) |
| 3 | 0.699 (0.971) |
| 4 | 1.189 (0.968) |
| 5 | 2.097 (0.972) |
| 6 | 3.457 (0.969) |
| Log-likelihood | −2,291.405 |
| Chi2 (23) | 192.85 |
| Prob > chi2 | <0.001 |
| Number of obs. | 1,280 |

*Note:* A higher coefficient indicates higher purchase likelihood when compared to the base variable.
£ ***, **, * indicate $P$-values of ≤0.001, ≤0.010, and ≤0.100.
†Eye-tracking variables included total visit duration proportions (TVDPs). Eye-tracking variables were calculated by dividing the specific attribute eye movement recordings by the total image eye movement recordings. For example, TVDP_certified organic = ($TVD_{\text{certified organic}}$ / $TVD_{\text{total image}}$).

Table 4
Fruit-producing plant ordered logit regression estimates ($n = 95$)

| Attribute variables | Coeff. (Std. Err.)£ |
|---|---|
| Price | −0.072 (0.022)*** |
| Certified organic | 0.887 (0.156)*** |
| Organic production | 0.533 (0.125)*** |
| Conventional | Base |
| In-state | 0.513 (0.118)*** |
| Domestic | 0.379 (0.116)*** |
| Import | Base |
| Sociodemographic variables | |
| Age | −0.015 (0.008)* |
| Gender | 0.254 (0.303) |
| Income | −0.008 (0.004)* |
| Child | 0.543 (0.428) |
| Relationship | 0.239 (0.346) |
| Household | 0.143 (0.074)* |
| Education | −0.403 (0.292) |
| Total visit duration proportion variables† | |
| TVDP_plant | 1.275 (1.628) |
| TVDP_price | −0.655 (3.863) |
| TVDP_certified organic | 0.653 (2.160) |
| TVDP_organic production | 6.142 (2.581)* |
| TVDP_conventional | −2.216 (2.256) |
| TVDP_in-state | 0.724 (2.169) |
| TVDP_domestic | −1.990 (1.603) |
| TVDP_import | −0.664 (1.771) |
| Threshold parameters | |
| 1 | −2.487 (0.908) |
| 2 | −0.828 (0.896) |
| 3 | −1.289 (0.886) |
| 4 | −0.898 (0.879) |
| 5 | 0.103 (0.875) |
| 6 | 1.032 (0.885) |
| Log likelihood | −1,438.635 |
| Chi2 (20) | 127.90 |
| Prob > chi2 | <0.001 |
| Number of obs. | 801 |

*Note:* A higher coefficient indicates higher purchase likelihood when compared to the base variable.
£ ***, **, * indicate $P$-values of ≤0.001, ≤0.010, and ≤0.100.
† Eye-tracking variables included total visit duration proportions (TVDPs). Eye-tracking variables were calculated by dividing the specific attribute eye movement recordings by the total image eye movement recordings. For example, TVDP_certified organic = ($TVD_{\text{certified organic}}$ / $TVD_{\text{total image}}$).

Marginal effects were estimated to show the marginal changes in predicted probability for each attribute's PL (online appendix, Table 1A). For the indoor foliage plants, the price attribute had a decreasing probability of purchase at each level. Certified organic and organic production attributes had an increasing probability of purchase. In-state and domestic plants had an increasing probability of purchase. High VOC removal had an increasing probability, while low VOC removal had a decreasing probability of selection. Visual consideration of the plant image and import positively affected the probability of purchase. Visual consideration of conventionally produced negatively impacted participants' probability of purchase. The sociodemographic variable child negatively impacted the probability of participants' PL.

### 5.2. *Preferences for fruit-producing plants*

Similar to indoor foliage plants, price negatively affected consumers' PL (Table 4). Certified organic and organically produced signs positively impacted consumers' PL when compared to conventional production, supporting hypothesis 1. Participants' PL was greater for in-state and domestic plants than imported plants, supporting hypothesis 2. The production method and origin results are consistent with Hawkins et al. (2012) and Yue et al. (2011).

Older participants were less likely to purchase fruit-producing plants than their younger counterparts (Table 4). A higher household income decreased participants' PL for fruit-producing plants. Participants with larger household sizes were more likely to purchase the plants. Gender, child, relationship status, and education level did not affect PL.

Greater visual consideration of certified organic and conventional production methods had no effect, meaning that there was no difference between the instinctive and considered responses (Table 4). More visual consideration of organic production positively affected PL, supporting hypothesis 3. Since visual attention increases with decision complexity (Arieli et al., 2011), the organic production results may be linked to consumers' positive perceptions of organic products and the complexity of interpreting what is meant by "organic production" (Campbell et al., 2013). Regarding visual consideration of origins, there were no significant differences. Hypothesis 4 was not supported for fruit-producing plants. The lack of difference in visual consideration of the origin signs may be partially explained by origin being less important (since visual attention can depict attribute importance as discussed by Behe et al. (2014)) or due to ease of interpretation (Arieli et al., 2011). Both explanations lead to less visual consideration of the attributes. Visual consideration of the plant image and price did not significantly affect PL.

The fruit-producing plant marginal effect results showed that the price attribute had a decreasing probability of purchase at each level (online appendix, Table 2A). The certified organic and organic production attributes had an increasing probability of purchase when compared to conventionally produced plants. In-state and domestic attributes had an increasing probability of purchase when compared to imported plants. The sociodemographic variables age and income negatively impacted the probability of participants' PL for fruit-producing plants. Household size positively influenced the probability of purchase. Visual consideration of organically produced positively impacted the probability of purchase.

### *5.3. Willingness-to-pay*

WTP estimates were generated from the ordered logit model results (Table 5). For the indoor foliage plants, participants were willing to pay the highest premium ($19.47) for in-state plants, followed by certified organic ($13.96), high VOC removal ($13.81), and domestic ($12.82). Consumers required a discount (−$7.53) to purchase plants with a low VOC removal rate. For the fruit-producing plants, consumers were willing to pay the most ($12.36) for certified organic plants, followed by organic production ($7.43), in-state ($7.15), and domestic ($5.28) origins. The WTP estimates support hypothesis 1 (consumers prefer organically produced plants over conventionally produced plants) and hypothesis 2 (local and domestic plants are preferred more than imported plants) regardless of plant type.

Table 5
Willingness-to-pay estimates (in USD) from the ordered logit model coefficients

| | Indoor foliage plants£† | Fruit-producing plants£† |
|---|---|---|
| Certified organic | $13.962* | $12.357* |
| Organic production | $9.781* | $7.425* |
| In-state | $19.465* | $7.149* |
| Domestic | $12.818* | $5.275* |
| High VOC removal | $13.805* | — |
| Low VOC removal | −$7.531* | — |

£ ***, **, * indicate $P$-values of ≤0.001, ≤0.010, and ≤0.100, respectively.
†Willingness-to-pay estimates were calculated by the following equation: $WTP_{certorg} = -(\beta_{certorg} / \beta_{price})$.

## 6. Conclusion and discussion

Our study analyzed consumers' PL and visual attention to organic production methods and origin extrinsic cues on esthetic and fruit-producing plants. A rating-based conjoint analysis experiment, combined with eye-tracking technology, was used to solicit consumer preferences and analyze choice behavior. The bivariate variable results revealed that consumers prefer certified organic and organically produced plants over conventionally produced plants, which is consistent with the previous literature (Schimmenti et al., 2013) and likely due to perceptions of improved personal and environmental health (Yue et al., 2011). Additionally, in-state and domestic plants were preferred to imported plants, which is comparable with previous studies (Hawkins et al., 2012; Yue et al., 2011) and is potentially due to perceived quality and economic benefits (Yue et al., 2011). The bivariate variable results indicate robustness of results.

TVDP results were used to elicit consumers' visual consideration and its correlation with PL. Overall, greater visual consideration of organic production methods was correlated with PL for fruit-producing plants. These results indicate that in-store promotions of organic production methods effectively prompt consumers to increase their consideration of those products. Additional consideration of organic production methods triggered a positive purchase response. Results could guide marketing campaigns for organic products. Furthermore, results indicate that there is potential to use alternative, sustainable production methods (besides certified organic) to stimulate consumer consideration and improve purchase intent. We conclude that organic production methods could be a viable value-added strategy for plant producers and retailers for fruit-producing plants in Florida.

Consumers' visual consideration of the origin attribute was more complex. Visual consideration of the in-state attribute was not significant for both types of plants, while, for indoor foliage plants, visual consideration of the import attribute caused a positive response from consumers. Overall, the visual results indicate that some in-store origin promotions encourage consumers to spend more time visually considering (and perhaps thinking about) that product (import promotions), whereas others trigger a more instinctive response (in-state promotions). This is potentially caused by the study location since Florida residents are likely more familiar with the in-state promotional campaign than the other two origin options that reduces the need for additional visual consideration (Aribarg et al., 2010). If this is the case, it justifies agency and association advertising and promotional expenditures in order to increase consumers' familiarity with in-state marketing campaigns provided that the results are positive (as indicated by the bivariate variable results). In turn, this could increase grower and retailer buy-in that makes in-state products more available to end consumers.

### *6.1. Limitations*

Although the results provide several interesting insights on value-added attributes, visual attention, and consumer behavior, there are several limitations that must be acknowledged. First, to facilitate the use of eye-tracking technology, our sample was localized. Consequently, our results are only applicable to Florida and similar studies in the United States would be required to test the robustness of the results. Second, although rating-based conjoint analysis was used to elicit consumers' PL, it can be argued that data generation approaches such as the discrete choice experiments (DCEs) offer stronger theoretical basis in neoclassical utility theory (Louviere et al., 2010), and provide a more robust indication of consumer preferences (Ben-Akiva et al., 2015; Hensher et al., 2015). Finally, our model specification did not account for preference heterogeneity. Future research relaxing the assumption of preference homogeneity could test the validity of this framework and advance our understanding of visual search behavior and preferences for organic production and origin promotions.

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