Incorporating Eye Tracking Technology and Conjoint Analysis to Better Understand the Green Industry Consumer

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Abstract. Plants are often merchandised with minimal packaging; thus, consumers have only the plant (intrinsic cue) or information signs (extrinsic cues) on which to assess the product and base their purchase decision. Our objective was to segment consumers based on their preferences for certain plant display attributes and compare their gaze behavior when viewing plant displays. Using conjoint analysis, we identified three distinct consumer segments: plant-oriented (73%), production method-oriented (11%), and price-oriented (16%) consumers. Using eye tracking technology, we show that subjects spent more visual attention to cues in the horticultural retail displays that were relatively more important to them. For example, plant-oriented consumers were the fastest segment to fixate on the plants and looked at the plants for longer amounts of time compared with the other segments. Production method-oriented consumers looked at the labeling related to production method for a longer duration, whereas the price-oriented consumer looked at the price sign the longest. Findings suggest that retailers should carefully consider the type of information included on retail signage and the visual impact it has on different consumers.

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Cue use is the cognitive process of gathering information from the external environment and using it to make a decision (Olson, 1978). There are many cues available in the shopping environment (e.g., labels/signs and the merchandise itself), which the consumer could use to make product assessments or a purchase decision. Olson (1972) categorized cues as either intrinsic (e.g., product ingredients or the product itself) or extrinsic (e.g., price, brand, package, etc.). He also posited a two-step cue assessment theory in which consumers first identify important cues

before using them in judgments. Decades of consumer research has documented the persistent impact that price has on product perceptions (Dodds et al., 1991; Gabor and Granger, 1961; Janakiraman et al., 2006; Rao, 2005; Vanhuele et al., 2006). Other extrinsic cues such as brand (Allison and Uhl, 1964; Richardson et al., 1994) and packaging (Koutsimanis et al., 2012; McDaniel and Baker, 1977) are often also assessed when consumers make product choices.

With respect to plant purchasing, plant quality is nearly always identified as an important purchase factor to consumers (Behe and Barton, 2000; Hudson et al., 1997; Klingeman et al., 2004). Because plants are sold with very little packaging and often do not have brand names, consumers mainly use intrinsic cues (the plant themselves) and extrinsic cues (tags or signs when available) in the purchase decision. Understanding the consumer segment that uses each type of cue can help retailers improve the shopping process, which may lead to greater customer satisfaction and improved sales.

To better understand the role of intrinsic and extrinsic cues, researchers have typically relied on various techniques such as focus groups and experiments. As technology has evolved, researchers have explored the use of new techniques to examine drivers of purchase. Recently developed technologies such as eye tracking technology (ETT) allow researchers to see exactly what the consumer sees, thereby allowing for a better understanding of the consumer mind set. Given its recent adoption, the literature using ETT on retail plant displays is sparse. To fill this void and examine the potential impact on the green industry, we used ETT to investigate what captures attention in horticultural retail displays to better understand cue use. Our objective was to investigate the use of intrinsic cues (plants) and extrinsic cues (signs) in retail plant displays with ETT. Using visual behavior data within conjoint analysis framework, we gain a better understanding of how consumers view cues during the purchase decision.

An important contribution of this study to both methodological and applied research is the unique combination of visual behavior and stated preference data within the choice analysis framework. The first component—conjoint analysis—has routinely been used to understand the effects of product attributes and demographic characteristics on choice decisions. Conjoint studies have been used as a means to elicit consumer preferences for a wide range of ornamental products such as Christmas trees (Behe et al., 2005b), landscapes (Behe et al., 2005a; Zagaden et al., 2008), plant containers (Hall et al., 2010), and mixed flowering annual containers (Mason et al., 2008). Hall et al. (2010) found that 13% of plant preference survey participants valued an extrinsic cue, carbon footprint label, more than other product cues such as price, plant container type, and waste composition in the container. Building on that study, Behe et al. (2013b) used a conjoint design to identify nine consumer segments,

focusing on their gardening purchases, and documented differences in consumer preferences for plant provenance and environmental attributes of transplants.

Although techniques such as conjoint analysis are invaluable to understanding the consumer mind set, most cases use stated preference data, which has been subject to criticism for systematic biases (e.g., hypothetical commitment bias) (Carson and Louviere, 2011). Hence, the second component of our framework—ETT—can be applied in conjunction with commonly used experimental techniques (e.g., conjoint analysis) to mitigate these biases and gain an in-depth understanding of behavioral mechanisms underlying consumers' choice decisions. Wedel and Pieters (2008) reported that, "The areas in the visual brain are highly specialized to process information collected during eye fixations and continuously interact with areas that direct eye movement to salient and/or informative locations in visual scenes and stimuli, which enables purposeful and goal-directed eye movement" (p. 13–14). In other words, people do not look randomly and the subconscious movement of the eye is guided by the type of information sought and its value to the task at hand. The bulk of the peer-reviewed studies using ETT investigated the process of reading by following eye movements (see Rayner, 1998, for a 20-year review of this subject).

Visual behavior data were previously used to investigate whether branded products receive more visual attention compared with unbranded products regardless of product size (Teixeira et al., 2010). Meissner and Decker (2010) demonstrated that consumers spent more time (fixations) viewing product attributes that were more important to them. Kuisma et al. (2010) found that animation in online advertisements drew the viewer's attention more for vertical advertisements compared with horizontal advertisements. Patalano et al. (2009) documented that consumer indecisiveness was positively related to time spent viewing information about the purchase as well as time spent looking away from information directly related to that choice task. ETT methods have also been used to examine the effects of package label design on individual choice decision-making behavior. For example, Bix et al. (2009) investigated the prominence of package warnings on over-the-counter medicines and found that they were not readily viewed by consumers. Sorensen et al. (2012) showed that a product name on a label attracted six times more attention than any organic production claim, whereas illustrations captured more attention than health claims, even if the illustration was irrelevant. Behe et al. (2013a) recently demonstrated the potential use of ETT for analyzing green industry consumer behavior.

Methodology

Participants. Subjects were recruited to the study by various means (Craig's List,

local newspaper advertisements, and flyers posted proximate to the study locations) in six North American universities or research centers, including Apopka, FL; College Station, TX; West Lafayette, IN; East Lansing, MI; St. Paul, MN; and Vineland Station, Ontario, Canada. These locations were chosen given their geographic distance to the participating institutions, but also given their dispersion throughout the United States and Canada. The number of panelists per location ranged from 48 to 67. The total number of individuals who agreed to participate in the study was 330.

Experiment design and procedures. During the Summer 2012, the 330 participants were scheduled and invited to participate in an on-site survey to better understand the plant purchase choice decision-making. Each panelist was given a \$25 incentive for participating in the experiments. After being informed about the study purpose and signing an Institutional Review Board-approved informed consent form, subjects completed the demographic portion of the survey questionnaire. They were subsequently seated in front of the ET device (Tobii X1 Light, Danderyd, Sweden) and were oriented with and calibrated to the equipment (Behe et al., 2013a). The ET device allows researchers to track/record eye movement across a computer screen. The ET device attaches to the bottom of the screen and refracts infrared beams of light off the eye pupil. The device captures the position on which the pupil is fixating or moving on the image/screen and records the sequence of gaze pattern at millisecond intervals. ET data are captured at the millisecond level, and as noted by Herpen and van Trijp (2011), differences in fixations at the second and millisecond level can provide meaningful results. For detailed information on time to calibrate and ET survey guidelines, see Behe et al. (2013a).

During orientation and calibration, participants were encouraged to sit as still as possible while viewing the displays on a computer screen. The visual data collection began with the subject viewing a sample display to become familiar with the study protocol. Next, participants were asked to verbally indicate how likely they were to purchase a plant within the display using a 10-point Likert willingness to purchase scale, where 1 = not at all likely to buy and 10 = very likely to buy. To reduce participant movement during the ET session, a researcher recorded the verbal response as a colleague advanced the screen to the next profile. To minimize order bias, the profile presentation was randomized between survey locations. Furthermore, the same laptop and computer screen were used at each location to ensure the image quality and size were the same between locations. After viewing the 16 images, subjects completed supplemental questions with regard to their past plant purchases and other attitudinal and behavioral questions.

The images of plants were shown in 16-cm containers and were selected to represent

transplants that were 1) food-producing; 2) edible; and 3) ornamental in nature. The plant type attribute was made up of three levels: mixed herbs, assorted vegetable plants, and petunias. The three price levels were: \$1.99, \$2.49, and \$2.99/plant. This range of prices was chosen after examination of prices at various garden centers in the cities used as venues for this research. Given the increasing popularity of environmental friendliness, understanding how consumers view environmental labeling is essential. We included three environmental production practice levels: "grown using water-saving practices," "grown using energy-saving practices," and "grown using sustainable practices," which were compared with the "grown using conventional practices" label. Information about consumers' valuation of attributes such as water-saving and energy-saving practices can benefit marketers to improve retail displays by messages that are relevant to end-users. From a production perspective, these practices have the potential to lower the need for water and energy, which are critical and often expensive inputs in plant production. However, if a producer is able to influence consumer demand for plants produced in a water- or energy-saving manner, then they can potentially increase their sales and/or receive a price premium.

The identification (ID) of the attributes and levels to be included in the survey are of critical importance. Using the results of previous studies, notably Behe et al. (2013b) and Hall et al. (2010), and consultations with retail garden center managers, we developed a conjoint experimental design consisting of a variety of intrinsic (plant types) and extrinsic (price and production practice) attributes. The combination of three attributes and corresponding levels represented a three $\times$ four $\times$ three design, i.e., three (plant types) $\times$ four (production practice levels) $\times$ three (price levels) design. Given the number of attributes and levels, the total number of possible product profile combinations was 36, which could result in cognitive burden and fatigue for the respondents. By using a fractional factorial design, the minimum number of stimuli was reduced to 16 plant profiles. Each plant profile shown to the participants consisted of a picture of a retail plant display, which was taken by the authors at a garden center in Dallas, TX, in Spring 2012. Using the display at the garden center and researchers' experience, a representative retail display was constructed that consisted of the desired plant type with three blank signs. After photographing the needed profiles, researchers used Adobe Photoshop to digitally add the prices and production practices onto the blank signs. The center sign always indicated the type of plants in the display (e.g., "assorted fresh herb plants," "annual petunias assorted colors," or "vegetable plants") given this is customary in most retail plant displays. The left sign always indicated the production practice, whereas the right sign always indicated the price per plant in the display. From each

profile, the same pictures for herbs, petunias, and vegetables were used, ensuring no outside variation was introduced into the design. Furthermore, the sign text was the same font size and style across all signs and profiles.

After the ET experiments, Tobii Studio-3.0.2.218 (Tobii, Danderyd, Sweden) software was used to compile the visual metric calculations and specify areas of interest (AOIs). An AOI is a section of the image that the researcher chooses (by selecting a specific area of an image) to analyze in greater detail. For this study, four AOIs were created, one AOI for each sign and one for the plant display (not including the signs). The AOIs were drawn to fit each image closely (Fig. 1). To maintain consistency in AOI size and position among the 16 profiles, the AOI drawings were copied and pasted in place over each similar image in the test. After defining the AOIs for the profiles, the four metrics, time to first fixation (TFF), first fixation duration (FFD), total visit duration (TVD), and fixation count (FC) on each AOI, were calculated by the Tobii Studio Statistics tool.

The TFF is a measure of how many milliseconds it took a participant to first fixate on a particular AOI from the time the display (e.g., Fig. 1) appeared on the computer screen. A lower TFF implies the AOI commands attention. The FFD is the length of time in milliseconds that the participant fixated on an AOI during the first fixation. The TVD is the total time in milliseconds that the participant looked at a particular AOI. The FC is the number of times the participant fixated on an AOI.

Hypotheses. Consistent with Behe et al. (2013b) and Hall et al. (2010), we hypothesize (H₁) that the plant market is heterogeneous

with distinct market segments. Furthermore, we hypothesize (H₂) that the cues that are more important to a consumer will be visually found before less important cues. For instance, a price-sensitive consumer will find the price sign faster than a consumer who is not price-sensitive ($TFF_{Price\ Sensitive} < TFF_{Not\ Price\ Sensitive}$). We further hypothesize (H₃) that the cues that are more important to the consumer will also generate longer FFD, TVD, and a higher number of FCs compared with less important cues. Taking the price-sensitive consumer as an example, we expect that the price sign will see $FFD_{Price\ Sensitive} > FFD_{Not\ Price\ Sensitive}$, $TVD_{Price\ Sensitive} > TVD_{Not\ Price\ Sensitive}$, and $FC_{Price\ Sensitive} > FC_{Not\ Price\ Sensitive}$. In comparison across AOIs, we hypothesize (H₄) that the plant area AOI will have a faster TFF, TVD, FFD, and higher number of FCs across all consumer segments given it is larger than the other AOIs (typical in retail displays) and is arguably the most visually interesting (Fig. 1).

Lenzner et al. (2011) found that some study participants fixated longer when exposed to vague or imprecise terms, complex syntax, and low-frequency words or phrases. Because production method might contain unfamiliar or ambiguous terms (e.g., “sustainable,” see Campbell et al., 2013), we hypothesized (H₅) that the production method sign would have the longest TFF, FFD, and TVD across signage.

Analyses. Numerous econometric modeling techniques such as probit, logit, and Tobit regressions have been used to analyze conjoint designs. However, given our desire to obtain individual-level estimates to obtain consumer segments, we used ordinary least squares (OLS) to construct individualized models for each participant. A part-worth

utility framework was used whereby the dependent variable for each model was the Likert willingness to purchase rating, and the independent variables were the effects-coded attribute levels presented in the plant profiles. Therefore, the model was

$$RT_{ji} = \sum_{j=1}^{16} \beta_j X_{ji} + \epsilon_i \quad [1]$$

where RT represents the Likert rating of the *j*th product by the *i*th participant, *X* represents the *j*th product profile seen by the *i*th participant, and β is a vector of part-worth utility coefficients. Given that the attribute levels were effects coded, the part-worth utilities represent changes on the Likert willingness to purchase rating scale from the mean rating. After calculating the part-worth utilities, we calculated the relative importance of each attribute in the purchasing decision compared with the other attributes.

Similar preferences (i.e., part-worth utilities) can next be grouped together to form clusters of consumer, or market segments (Green and Helsen, 1989). Market segments should be measurable, accessible, substantial, differentiable, and actionable (Kotler and Armstrong, 2001). Following Behe et al. (2013b), we used a combination of objective and subjective criteria to identify the optimum number of segments. We used Ward's Linkage and Weighted Average Linkage algorithms in combination with the pseudo-f (Calinski and Harabasz, 1974) and pseudo-T² (Duda et al., 2001) “stopping rules” to objectively identify the optimum number of segments. After identifying the objective optimum, we examined the segments around the optimum to analyze if segments were substantial with respect to number of respondents while also providing information that could be used by industry. After the objective and subjective tests were completed, three consumer segments (“plant-oriented,” “production practice oriented,” and “price-oriented”) were identified.

Using these segments, a multinomial logit model (ML) was used to identify any differences in demographics or purchasing behaviors that might increase the probability of being a member of a certain segment. The ML specification was as follows (Greene, 2003, p. 721):

$$Prob(S_i = j) = \frac{e^{\beta_j' x_i}}{\sum_{k=1}^3 e^{\beta_k' x_i}} \quad \text{where } j = 1, 2, 3 \quad [2]$$

where $Prob(S_i = j)$ is the probability participant *i* was in segment *j*, *k_i* is a set of demographic and purchasing behavior variables, and β_j is a vector of parameters estimates. From the ML model, marginal effects were calculated at the means and are discussed in the “Results” section. Descriptive statistics for the explanatory variables can be found in Table 1. Along with identifying which demographics and purchasing

Fig. 1. Areas of interest imposed on a sample display used to compare respondent gaze behavior when viewing plants and signage within the plant displays.

Table 1. Means for the total sample and by segment from a 2012 study using eye tracking coupled with conjoint analysis associated with explanatory variables used in the multinomial logit model.

	Total	Plant-oriented	Production method-oriented	Price-oriented
State/province				
Ontario	19%	20%	21%	15%
Florida	15%	14%	26%	11%
Texas	18%	19%	9%	20%
Minnesota	14%	12%	26%	19%
Michigan	20%	20%	15%	24%
Indiana	14%	16%	3%	11%
Age	48.31	47.82	53.50	46.72
Gender: male	29%	31%	21%	24%
Number of adults	1.14	1.19	0.76	1.19
Number of children	0.49	0.48	0.56	0.59
Ethnicity: white	88%	86%	97%	89%
Education				
High school degree or less	11%	13%	6%	6%
2-year college	28%	27%	32%	30%
Bachelor's degree	33%	35%	24%	37%
Higher than Bachelor's	28%	25%	38%	28%
Area				
Urban	59%	56%	79%	63%
Metropolitan	17%	17%	12%	19%
Rural	24%	27%	9%	19%
Income	\$70,650	\$69,793	\$72,685	\$72,258
Percent food budget spent on organic fresh produce	20%	21%	24%	15%
Have a lawn (1 = no)	12%	13%	6%	7%
Dollars spent on garden supplies and plants, last 6 months	\$338	\$331	\$381	\$339
Percent of plant purchases are locally produced	56%	55%	60%	61%
Location of purchases				
Independent garden center	71%	71%	82%	63%
Home improvement or hardware store	65%	63%	74%	67%
Supermarket or grocery store	40%	43%	32%	35%
Mass merchandiser	15%	14%	24%	19%
Other	23%	23%	24%	22%
Plants purchased, last 6 months				
Annual flowering	69%	70%	74%	65%
Vegetable	56%	55%	65%	46%
Herb	50%	49%	56%	48%
Flowering perennials	57%	56%	74%	50%
Shrub (flowering and non-flowering)	34%	33%	47%	26%
Tree	25%	26%	24%	24%
Indoor flowering potted	42%	42%	56%	33%

behaviors increase the probability of segment membership, we also used a multiple comparison test to determine if differences existed among TFF, FFD, TVD, and FC across each consumer segment for each sign (e.g., for price sign was $TFF_{\text{Price-oriented}} < TFF_{\text{Plant-oriented}}$).

Results and Discussion

The average R^2 across all individual OLS models was 0.76, implying good fit for the models. For the conjoint analysis results, on average, respondents placed 50% of the relative importance (RI) on plant type, 27% on production methods, and 23% on price (Table 2). RI can be defined as the amount of importance an attribute contributes to the overall purchase decision (Hair et al., 1998). This was consistent with other findings where, on average, study participants ranked the RI of plant type highest (Behe et al., 2013b; Hall et al., 2010). We did find diversity in RI among the 330 participants, supporting H_1 (The plant market is heterogeneous with distinct market segments.). Using the clustering procedure described previously to derive the market segments: 73% were categorized as plant-oriented, 11% as production method-oriented, and 16% were

classified as price-oriented (Table 2). Members of the plant-oriented segment placed 7% more RI on plants compared with the sample in total. Members of the production methods segment placed 18% less RI on plant type, falling second to production method. For members of the price-oriented segment, RI of plant type dropped 20% to second place, whereas the RI of price increased 22% and ranked first.

In examining the part-worth utilities in Table 2, we observed that the moderately priced product (\$2.49) was preferred over both lower and higher priced products, which is inconsistent with prior studies where lower prices were preferred. However, research has shown that consumers who are highly involved in a product category place less emphasis on the price cue than consumers who are less involved in the product category (Zaichowsky, 1988). Involvement is considered "a state of arousal, interest or motivation" in a product (Rothschild, 1984). Furthermore, price can be an indicator of quality, and the \$1.99 price is one of the lowest prices found on the market, which might negatively influence preferences. The potential subtle relationship between price and quality perception should be examined in the future.

Plants showing "conventional" production practices signs were substantially discounted (-0.21 ; Table 2). The coefficients for the non-conventional production practice attributes ranged from 0.04 to 0.09. The greatest increase in preferences was for water-saving production practices (0.09), although it was not different from energy-saving (0.07). The positive preference for energy-saving practices was consistent with Behe et al. (2013b).

Part-worth utilities varied between consumer segments much like RIs did. Examining the production method-oriented segment first, the results showed that conventional production method was the least preferred (-1.26), whereas substantial preference (on the magnitude of five to seven times larger) was placed on sustainable, water-saving, and energy-saving, which was more consistent with prior findings (Behe et al., 2013b). For the plant-oriented segment, we found that 57% of the purchase decision was based on plant type with little to no influence by production practice. The price-oriented segment preferred the middle price (\$2.49) with only small preference for the "environmentally friendly" production practices.

Using the marginal effects, we found that the three segments differed on a few demographic

Table 2. Mean relative importance and part-worth utility values for the total sample and by consumer segment.

	Total	Plant- oriented	Production method-oriented ^a	Price-oriented ^a
Number	330	242	34	54
Market share		73%	11%	16%
Relative importance (mean)				
Price	23%	19%	15%	45% ***
Production	27%	24%	53% ***	24%
Plant type	50%	57%	32% ***	30% ***
Part-worth utilities (mean)				
Intercept	6.61	6.54	6.93	6.71
Price (\$)				
1.99	-0.12	-0.15	0.10 ***	-0.16
2.49	0.30	0.17	0.17	1.00 ***
2.99	-0.18	-0.02	-0.26 ***	-0.84 ***
Production label				
Conventional	-0.21	-0.06	-1.26 ***	-0.22 **
Sustainable	0.04	0.00	0.29 ***	0.07
Energy-saving	0.07	0.01	0.52 ***	0.06
Water-saving	0.09	0.04	0.45 ***	0.09
Plant type				
Herb	0.05	0.04	0.38	-0.04
Vegetable	-0.10	-0.13	-0.24	0.08
Annual	0.05	0.09	-0.14	-0.04
R ²	0.76	0.77	0.78	0.73
Adjusted R ²	0.73	0.74	0.75	0.69

^at tests were used to compare the relative importance and part-worth utilities associated with the production and price segments to the main (total) segment.

*, **, and *** represent significant differences at the 0.1, 0.05, and 0.01 levels, respectively.

and behavioral parameters (Table 3). Geographically, the only statistically significant marginal effect was found for the indicator variable for Indiana. In other words, production method-oriented consumers were slightly less likely to have been from Indiana compared with those consumers from Ontario. Each additional adult in the household (above the average number of adults) increases the probability of being in the plant-oriented segment by 5.1% and decreases the probability of being in the production method segment by 4.4%. Plant-oriented consumers were 9% more likely to live in rural areas, whereas production method-oriented consumers were 3% less likely to live in a rural area compared with an urban area. Price-oriented consumers were slightly less likely to have spent a higher percentage of their food budget on organic products. Not surprisingly, plant-oriented consumers were 8% more likely to have a lawn but slightly less likely to have purchased a higher percentage of local plants. Price-oriented consumers were slightly more likely to have bought a higher percentage of their plants locally. Production method-oriented consumers were slightly more likely to have spent a higher amount on garden supplies and plants in the 6 months before the study. Consumers in this segment were also slightly more likely to have purchased plants from a mass merchandiser.

Visual data analysis. TFF is a metric indicating the amount of time an element (i.e., an AOI) took to capture attention, so lower times indicate an element that commanded attention quickly. Because the plant ID sign was centrally located on every image, we anticipate it to have the shortest TFF, consistent with central gaze theory (Atalay et al.,

2012; Christenfeld, 1995; Shaw et al., 2000). However, only the plant-oriented consumer segment had the lowest TFF for the plant ID sign compared with the other signs (Table 4). For instance, it took the plant-oriented segment 1.15 s to fixate on the plant ID sign while taking 1.23 and 1.89 s to fixate on the production and price signs, respectively. However, the production-oriented segment took 1.27 s to fixate on the plant ID sign and 0.90 and 2.01 s to fixate on the production and price signs, respectively. There may be two plausible explanations for this result. First, people tend to read/look left to right implying that because the production sign was on the left, then it was fixated on faster. However, if this were the case, then we would expect the plant-oriented segment to have a lower TFF for the plant ID sign, which does not occur. More likely the reason for the production and price-oriented segments fixating on the production sign fastest is the result of the sign containing unfamiliar, irrelevant, or confusing information, consistent with Lenzner et al. (2011). In other words, the plant-oriented segment was most likely fixating on the plants to come up with valuations, whereas the production and price-oriented consumers were making valuations based on production and price.

With respect to TFF differences associated with specific signs/plants across segments (H₂: the cues that are more important to a consumer will be visually found before less important cues), the results showed that the plant ID sign had a shorter TFF for the plant-oriented group (1.15 s) compared with the other groups (production-oriented = 1.27 and price-oriented = 1.35), supporting H₂. Furthermore, the plant-oriented segment had a lower TFF (0.79) for the plant material compared

with the production (1.21) and price (1.62)-oriented segments. For the production sign, the production-oriented consumers had a lower TFF compared with the plant-oriented consumers. Finally, the price-oriented segment had a lower TFF for the price sign compared with the other segments. These results fully support H₂ that consumers with varying drivers of purchase will first fixate on those aspects of the sign/product of interest to them.

FFD is an indication of the time used to process information from the first fixation (Table 5). The plant-oriented segment had the longest FFD on the plants compared with the other two segments, 0.04 and 0.02 s, more than that of production and price-oriented consumers. This finding supports H₃. (Cues that are more important to the consumer will also generate longer FFD, TVD, and a higher number of FCs compared with less important cues.) However, all three segments spent the lowest FFD on the plants, which does not support H₄. (The plant area AOI will have a faster TFF, TVD, FFD, and higher number of FCs across all consumer segments.) The price sign had the third longest FFD for all three groups and was equally long across them. The FFD for the production sign was longest for all three groups. However, for the price-oriented group, FFD was 2 ms shorter than for the production method-oriented segment and 1 ms shorter than for the plant-oriented segment. Thus, H₃ was partially supported in that FFD on price was shorter than FFD on production method sign, but FFD on plants was not shorter than FFD on the plant ID sign.

TVD is an indirect measure of cognitive processing in that it is a product of FC multiplied by fixation duration per visit. Table 6 shows the TVD for each of the four AOIs by segment. When comparing the TVD on each of the three signs, the results showed that the TVD on the central sign (plant ID) was lower than the production method sign for all three segments, supporting H₄. Members of all three segments had the highest TVD on the plants, also supporting H₄. However, in comparing the mean TVD by segment, the plant-oriented segment had a longer TVD on the plants compared with the other two segments. The production method-oriented segment had a longer mean TVD on the production method sign compared with the other two groups. The results also revealed that the price-oriented consumers had a longer TVD on the price sign compared with the other segments.

Furthermore, the results showed that the production sign does have the highest TVD across all signage for each market segment. From these results for TVD, we find that H₃ (cues that are more important to the consumer will also generate longer FFD, TVD, and a higher number of FCs compared with less important cues) and H₅ (the production method sign would have the longest TFF, FFD, and TVD across signage) are supported. Our findings support H₃ (cues that are more important to the consumer will also generate longer FFD, TVD, and a higher number of

Table 3. Marginal effects calculated at the means (representing the likelihood of inclusion in each segment for each independent variable) for each segment from the multinomial logit model.

Variables ^z	Plant-oriented		Production method-oriented		Price-oriented	
	Coefficient ^y	Significance	Coefficient ^y	Significance	Coefficient ^y	Significance
State/province						
Florida	-0.0353	0.703	0.0081	0.756	0.0272	0.760
Texas	-0.0407	0.677	-0.0246	0.163	0.0653	0.498
Minnesota	-0.1508	0.183	0.0546	0.345	0.0962	0.366
Michigan	-0.0637	0.538	-0.0152	0.512	0.0789	0.444
Indiana	0.0595	0.501	-0.0366	0.067	-0.0229	0.791
Age	0.0004	0.841	0.0010	0.175	-0.0013	0.437
Gender: male	0.0634	0.164	-0.0136	0.371	-0.0498	0.253
Number of adults	0.0505	0.088	-0.0437	0.019	-0.0068	0.785
Number of children	-0.0309	0.184	0.0120	0.125	0.0189	0.388
Ethnicity: white	-0.0699	0.247	0.0265	0.143	0.0434	0.453
Education						
2-year college	-0.1450	0.179	0.0345	0.357	0.1106	0.299
Bachelor's degree	-0.0857	0.410	0.0043	0.880	0.0814	0.422
Higher than Bachelor's	-0.1784	0.137	0.0591	0.246	0.1192	0.306
Area						
Metropolitan	0.0318	0.582	-0.0192	0.210	-0.0126	0.821
Rural	0.0934	0.054	-0.0342	0.039	-0.0592	0.200
Income	0.0000	0.992	0.0000	0.869	0.0000	0.947
Percent food budget spent on organic fresh produce	0.0035	0.047	0.0003	0.410	-0.0037	0.034
Have a lawn (1 = no)	0.0885	0.100	-0.0096	0.642	-0.0790	0.104
Dollars spent on garden supplies and plants, last 6 months	-0.0003	0.214	0.0002	0.072	0.0001	0.571
Percent of plant purchases are locally produced	-0.0015	0.079	-0.0001	0.671	0.0016	0.049
Location of purchases ^x						
Independent garden center	0.0413	0.494	0.0049	0.783	-0.0462	0.424
Home improvement or hardware store	-0.0205	0.691	0.0048	0.771	0.0157	0.750
Supermarket or grocery store	0.0556	0.200	-0.0160	0.322	-0.0396	0.327
Mass merchandiser	-0.1107	0.115	0.0648	0.046	0.0459	0.472
Other	-0.0419	0.499	0.0164	0.417	0.0255	0.666
Plants purchased, last 6 months ^y						
Annual flowering	0.0763	0.187	-0.0396	0.180	-0.0367	0.475
Vegetable	0.0443	0.377	0.0213	0.270	-0.0656	0.159
Herb	-0.0194	0.683	-0.0184	0.322	0.0378	0.382
Flowering perennials	-0.0233	0.642	0.0279	0.184	-0.0046	0.920
Shrub (flowering and non-flowering)	0.0387	0.445	-0.0022	0.895	-0.0365	0.441
Tree	0.0121	0.821	-0.0119	0.437	-0.0002	0.997
Indoor flowering potted	0.0106	0.840	0.0135	0.380	-0.0241	0.635
Observations			330			
Wald χ^2			103.18			
$P > \chi^2$			0.0014			
Log pseudo-likelihood			-202.816			
Pseudo R^2			0.19			

^zBase categories include: Ontario, female, other ethnic heritage, high school diploma or less, urban, and have a lawn.

^yBold values indicate significant differences at the 0.1 level; see P value for the exact level.

^xFor the location of purchase (and plants purchased) variables, the respondent could mark any of the stores (or plant types), so the base category is did not purchase from (did not purchase this type of plant).

*, **, and *** represent significant differences at the 0.1, 0.05, and 0.01 levels, respectively.

Table 4. Time to first fixation (in seconds) by segment during the eye tracking portion of the study.^z

	Segment		
	Plant-oriented	Production method-oriented	Price-oriented
	Avg time (seconds)		
Production sign	1.23 ^A	0.90 ^B	1.17 ^A
Plant identification sign	1.15 ^A	1.27 ^{AB}	1.35 ^B
Plant material	0.79 ^A	1.21 ^B	1.36 ^B
Price sign	1.89 ^A	2.01 ^A	1.62 ^B

^zA Bonferroni multiple comparison test was used to test for differences between the different segments. For example, a superscript B in the "Plant-oriented" segment for the production sign indicates that 0.90 is significantly different at the 0.1 level or less compared with the "Plant-oriented" and "Price-oriented" segments.

FCs compared with less important cues), that consumers look at the cues that they value, it is more important than ever for green industry firms to be aware of the effects of signage they use in their display. Furthermore, because our results also support H_5 (production signage has a higher TVD com-

pared with other signs), firms should be aware that production-method signs will take away viewing time from other signage regardless of whether the consumer values the production practice. Thereby, retailers wanting to focus less on production should use clear and concise terminology so that

consumers will fixate less on the production practice and more on other signage (or product) that the firm wants to emphasize.

Conclusions

Markets are not homogeneous, and it is not surprising that the consumers are heterogeneous in their preferences and the relative importance they place on different product cues. This study is one of the first efforts to document the relationship between the stated preference for products in a retail display and visual data collected with ET. There are many cues available in the shopping environment, including signs and the merchandise itself, which the consumer could use to make a purchase decision. Our results showed that plant-oriented consumers used the intrinsic cue (the plant itself) over other extrinsic cues (signs), consistent with

Table 5. First fixation duration (in seconds) and percent of total visual time spent on first fixation by segment during the eye tracking portion of the study.^z

	Segment					
	Plant-oriented		Production method-oriented		Price-oriented	
	Avg time (seconds)	Percent time for first fixation ^y	Avg time (seconds)	Percent time for first fixation	Avg time (seconds)	Percent time for first fixation
Production sign	0.40 ^A	59%	0.39 ^{AB}	34%	0.37 ^B	38%
Plant identification sign	0.26 ^A	49%	0.25 ^A	38%	0.25 ^A	38%
Plants	0.22 ^A	9%	0.18 ^B	9%	0.20 ^C	11%
Price sign	0.34 ^A	79%	0.32 ^A	51%	0.33 ^A	37%

^zA Bonferroni multiple comparison test was used to test for differences between the different segments. For example, a superscript AB in the “Plant-oriented” segment for the production sign indicates that 0.39 is not significantly different at the 0.1 level or less compared with the “Plant-oriented” and “Price-oriented” segments.

^yPercent of time for first fixation indicated the proportion of total time on the image that was accounted for by the first fixation.

Table 6. Total visit duration (in seconds) by segment during the eye tracking portion of the study.^z

	Segment		
	Plant-oriented	Production method-oriented	Price-oriented
	(seconds)		
Production sign	0.68 ^A	1.16 ^B	0.97 ^C
Plant identification sign	0.53 ^A	0.67 ^B	0.66 ^B
Plants	2.36 ^A	2.11 ^B	1.77 ^C
Price sign	0.43 ^A	0.63 ^B	0.89 ^C

^zA Bonferroni multiple comparison test was used to test for differences between the different segments. For example, a superscript B in the “Plant-oriented” segment for the production sign indicates that 0.68 is significantly different at the 0.1 level or less compared with the “Production method-oriented” (1.16) and “Price-oriented” (0.97) segments.

Olson’s (1972) two-step cue assessment theory in which consumers first identify important cues before using them in judgments. Overall, our data revealed congruency between cue preference and attention measures. For example, the plant-oriented segment fixed their gaze most quickly (TFF) on the preferred intrinsic cue (plant itself), whereas the production-oriented segment’s TFF was fastest for the production sign. Understanding consumer cue preferences can assist retailers in providing display cues that grab consumer attention.

Decades of consumer research has documented the persistent impact that price has on product perceptions. Price is a relatively common and simple message to convey. In this study we found that the price-oriented consumers had a longer TVD on the price sign compared with the other segments. This indicates they were thinking about price longer than individuals in other segments and longer than other extrinsic cues (i.e., production and plant ID sign). Given consumers’ tendency to choose an option in the center, the first fixation for our participants would be expected to be on the plant ID sign. For production method-oriented consumers, TFF was lowest on the production sign, not on the plants or the central ID sign. This cue (i.e., production sign) was high in RI in their stated cue preference as well as commanding their visual attention. Our results are comparable with previous empirical work (Meissner and Decker, 2010) in that consumers spend more time fixating on the cues that are important to them.

This study provides some of the first objective visual data, which relates stated

preference to eye movement. Our experiments showed that consumers identified and considered information consistent with their stated preference, supporting Olson’s (1972) theory. Findings suggest that retailers should carefully consider information included on signs and the relative importance those terms may have to a variety of consumers. A fruitful area for future study will be to investigate the relationship between relative importance of product cues and measures of attention to actual purchase behavior. This line of research is made feasible with the use of ET glasses at the point of purchase. Although ET can provide insights into what grabs consumer attention, these data need to be combined with other measures (e.g., product involvement, price sensitivity) to better understand why certain product cues are relevant.

We also find through ETT that not only does each consumer segment find the most important cue faster than the other segments, but they look at it longer. In a maturing green industry marketplace, this result can be extremely useful because retail firms need to not only catch attention, but showcase relevant information to increase the probability of each consumer purchase. A green industry firm can use the consumer profiles from our study to stress certain marketing messages with the knowledge that consumers do indeed look for them.

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