Are Consumers in Developing Countries Willing-to-Pay More for Micronutrient-Dense Biofortified Foods? Evidence from a Field Experiment in Uganda[1]

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Abstract: Vitamin A deficiency is a major health problem in Africa and in many other developing countries. Biofortified staple crops that are high in pro vitamins A and adapted to local growing environment have the potential to reduce the prevalence of vitamin A deficiency. One such example is the orange-fleshed sweetpotato. However because of its distinctive orange color, which is in contrast to the white varieties that are typically consumed in Africa, it is important to assess whether consumers will accept it. It is this question that this paper attempts to address, using a choice experiment with the real product to quantify the magnitude of the premium or discount in consumers' willingness to pay that may be associated with it. In addition, it also considers the extent to which the provision of nutrition information affects valuations. Finally, it addresses whether the use of hypothetical scenarios, both with and without a cheap talk script is justified in a developing country context, and quantifies the magnitude of hypothetical bias that results as a consequence. The experiment was conducted in Uganda, which is a key target country for the dissemination of orange-fleshed sweetpotato. Our results suggest that in the absence of nutrition information, there is no difference in the willingness to pay between white and orange varieties, but there is a discount for yellow sweetpotato (which does not have any beta-carotene). The provision of nutrition information does translate into substantial premia for the orange varieties, indicating that an information campaign may be key to drive market acceptance of the new product. Finally, there is a substantial hypothetical bias in both the WTP and the marginal WTP for the new varieties, and while cheap talk mitigates this bias, it does not eliminate it.

Keywords: Cheap talk, Field experiments, Hypothetical bias, Conjoint analysis, Universal logit
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Millions of people in developing countries suffer from micronutrient malnutrition. Vitamin A deficiency (VAD) for example, is a major public health problem, leading to vision problems and impaired immune systems; it is estimated that nearly 127 million pre-school children worldwide suffer from Vitamin A deficiency. Between 250,000 and 500,000 children go blind every year and over 600,000 deaths of children annually may be attributed to VAD (West Jr. and Darnton-Hill, 2001; Black et al, 2008). A major cause of micronutrient malnutrition is the poor quality of diets in developing countries. Good sources of vitamin A include fruits and vegetables, and animal and fish products; however, these foods are typically out of the reach of most poor people.

While there is no single strategy to eliminate micronutrient malnutrition, biofortification is emerging as a new intervention that can have significant impact, through the introduction of locally-adapted staple foods that are bred to be high in micronutrients (Bouis, 1999). One example is the orange-fleshed sweetpotato, which is high in beta-carotene, a precursor to vitamin A; the consumption of as little as 50 grams of OFSP a day may provide a child's recommended dietary allowance. Nutritionists have determined that the regular consumption of relatively modest amounts of boiled orange-fleshed sweetpotato (OFSP) by young school children in South Africa significantly improved their vitamin A status (Van Jaarsveld et al, 2005); and a similar result was obtained in a community setting by Low et al (2007).

As the name suggests, the biofortified sweetpotato is orange in color (because of the beta-carotene), in sharp contrast to the white and cream varieties that are commonly consumed. This unfamiliar appearance can be a major barrier to consumer acceptance and hence limit its potential impact on improving nutritional outcomes. This was the context for this study, whose primary objective was to elicit consumers' valuation of the orange fleshed (high beta-carotene) sweetpotato (OFSP).

Since biofortification is a public health intervention, the paper also attempted to assess the extent to which information on the nutritional value of the new biofortified foods influences consumers' willingness to pay. The literature—which pertains mostly to a developed country context—suggests that the impact of health information on food demand has been mixed. While McGuirk et al. (1995) and Kinnucan et al. (1997) found evidence of significant impact in the US context,[3] Robenstein and Thruman (1996) found no discernible impact on future prices from negative health information. In this paper, we examined the degree to which the provision of nutritional information influences the magnitudes of premia or discounts for OFSP relative to the more common white varieties.

A final objective of the paper was to assess the validity of hypothetical elicitation mechanisms in developing country settings. There is an extensive literature on the presence and extent of bias involved in valuations elicited from hypothetical scenarios, especially, in the natural resources literature (see Frykblom, 1997 for an early example). However, to our knowledge, these questions have not been systematically addressed in a developing country setting, as we have attempted in this paper. While valuations in absolute terms are likely to be overstated in a hypothetical scenario, it is possible that estimates of the marginal willingness to pay (for OFSP relative to white sweetpotato, for example) are not subject to the same degree of bias. In developed country settings, there is some evidence that marginal valuations are not as subject to hypothetical bias, as noted in List, Sinha and Taylor (2006) and Lusk and Schroeder (2004). However, Carlsson, Frykblom and Lagerkvist (2005) found evidence to the contrary.

One way to mitigate hypothetical bias is to use ‘cheap talk’ scripts proposed by Cummings and Taylor (1999) and subsequently used by List (2001) among others. We have attempted to test the validity of such an approach in reducing hypothetical bias in an African context. To the extent that there are relatively long time lags and substantial costs involved in producing sufficient quantities to test market a new staple food—the ability to use carefully-designed hypothetical scenarios with the inclusion of a ‘cheap talk’ script to mitigate any biases—can have significant programmatic implications.

This paper thus addresses three principal sets of questions: first, how much are consumers willing to pay for biofortified sweetpotato? Does the distinct color and perhaps taste of OFSP imply a price

[3] In fact the impact of health information in these studies found to be larger in magnitudes than the own-price effects.

discount/premium relative to the more familiar white sweetpotato varieties? Second, does information on the nutritional value of biofortified foods affect consumers' valuations? If so, by how much? Third, to what extent is it possible to elicit marginal willingness to pay using a hypothetical scenario? Does 'cheap talk', commonly used to mitigate hypothetical bias, result in magnitudes of premia or discounts that are comparable to those obtained from 'real' scenarios?

We attempted to answer these questions from a field experiment involving rural and urban consumers in Uganda. Sweetpotato is a major staple food in Uganda, especially among rural populations, and is the target for OFSP deployment efforts. Our sample was randomly assigned to one of four treatments: (1) those that received no information on the nutritional value of OFSP and were asked to make real choices with real commitments, (2) those that were told about the nutritional value of the OFSP and dealt with real choices and real commitments, (3) those who received nutrition information but were asked to make hypothetical assessments, and (4) those who received nutrition information and a cheap talk script, and then asked to make hypothetical choices.

We used a choice experiment (CE) to elicit valuations, which, in addition to possessing desirable theoretical properties, is also easy to implement in poor agrarian settings. CEs are consistent with random utility theory (McFadden, 1974) and Lancaster's theory of consumer demand (Lancaster, 1966, 1974). In addition, CEs can be designed to resemble actual purchasing scenarios where more than one product attributes can be simultaneously evaluated (Lusk and Schroeder, 2004). The experiment conducted here was a between-subject design where similar samples of respondents participated as subjects. While the experimental procedure is detailed in Section 2, we note that this is perhaps one of the few studies that attempted to examine these questions in a developing country setting, where real consumers in the field made purchase decisions.

Another notable feature of this study is the use of food science techniques to elicit taste preferences, in conjunction with the choice experiment. In the literature on the valuation of private goods, it is customary to estimate demand equations only over prices and quantities, and to attribute any significant unexplained part of data to 'taste'. This is primarily due to the assumption that individual preferences are constant and stable (see for example Stigler and Becker, 1977). In contrast, accounting for taste in valuation requires the incorporation of its determinants directly in estimation (Chalfant and Alston, 1988). This is rarely done in the valuations literature because of the lack of data on taste or the availability of adequate proxies for it. In this paper, we have used scales to measure sensory attributes and consumer acceptance (Tomlins et al., 2005, Tomlins et al., 2007).

The remainder of this paper is arranged as follows: Section 2 describes the general theory underlying the CE mechanism and the experimental design utilized in this study; Section 3 describes the estimation methods and presents the results; and Section 4 concludes and draws implications for further research.

Experimental Design

We used a discrete choice experiment (henceforth DCE) to elicit consumers' preferences for nutrition-dense biofortified sweetpotatoes (henceforth OFSP) in Uganda. Since OFSP was relatively new to consumers there, there was no market or revealed preference (RP) data available for analysis and some form of stated preference (SP) data need to be generated.[4]

The limitations of SP data, usually generated through various contingent valuation approaches where respondents do not face any real budget constraint, are well-known: they may not represent actual behavior and may not reveal the underlying preferences of consumers. Based on a meta-analysis, List and Gallet (2001) report that, in hypothetical settings, on average, subjects overstate their preferences by a factor of about three. The SP data generated for this study addresses this issue by ensuring that participants evaluate real products and face real budget constraints (although we also included hypothetical treatment arms for comparison).

[4] We have collected limited data from the market as a part of our post-experimental inquiry which is discussed in the Conclusions Section.

Among the various ways of eliciting SP, there has been growing interest in the use of DCE.[5] DCEs have a theoretical base in Lancaster's theory of consumer choice (Lancaster, 1966) which states that commodities can be described in terms of underlying attributes or characteristics, and that consumers value these attributes rather than the commodities per se. Choice experiments are also econometrically tractable as they are based on the random utility model (RUM) of behavior (McFadden, 1974).

DCEs not only enable a quantification of the premium or discount that biofortified staples may command, they also enable a disaggregation of the various attributes embodied in a new product. For example, subjects are able to make tradeoffs between a higher price, higher vitamin A content and a lower price but lower vitamin A content. Furthermore, when a DCE involves real money and real products, as in the current case, the common problems of hypothetical bias encountered in SP data can be avoided too.[6]

In the DCE, the consumer is assumed to make a choice from *j* alternatives. The utility that the *i*th consumer derives from choosing the alternative *j* consists of two components, a systematic component and a random component, and can be expressed as:

(1) $$U_{ij} = V_{ij} + \varepsilon_{ij}$$

Here V_{ij} is the systematic portion of the utility function determined by the product attributes and the rest is a stochastic element.

Assuming that consumers maximize their utility, the choice problem involves a comparison of utilities associated with each of the *j* alternatives, and a rational consumer makes choices among different alternatives that yield the maximum utility. Let Y_i be a random variable that denotes the choice outcome, then the probability that individual *i* chooses *j* is given by:

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[5] See the special issue of *Environmental & Resource Economics* (2006) vol. 34.
[6] However, if subjects are unfamiliar with the goods being valued, they might be influenced even in real settings. Goods used in the valuation in the current case were familiar to the subjects.

(2) $P(Y_i = j) = P(V_{ij} + \varepsilon_{ij} > V_{ik} + \varepsilon_{ik})$ for all k=1, …j; k≠j

The mapping from a probabilistic choice model to an econometric model of choice is conceptually straightforward and discussed in the Econometric Model Section.

The Field Design

In line with the questions set out in Section 1, there were four treatment arms to the study, each with approximately the same number of subjects. The first was what we term, 'real, without information'. It had 121 subjects. These subjects were asked to make purchase decisions on the prototype OFSP varieties, but were provided no information on their nutritional value. This was designed to mimic a strategy where the product would be supply driven, and can be construed as constituting a control group. In the second treatment arm, 'real with information' had 115 subjects, where subjects were told about the nutritional value of OFSP, because a consumer's decision may vary depending on the amount of information s/he has about a product, and was designed to examine the impact of a demand pull strategy on WTP. Since valuations may also differ depending on whether the transaction is hypothetical, as in a contingent valuation study, the third arm was implemented in a hypothetical setting, with information where we had 118 subjects, and in the fourth arm, the hypothetical setting was replicated using a cheap talk script where we had 113 subjects. The design is summarized in Figure 1 below, where the shaded cells represent the four treatments

[Insert Figure 1 here]

An almost equal number of participants were drawn from the rural areas of two districts (Kamuli and Luweero) and one urban district (Kampala). Table 1 shows the distribution of participants across treatments and their geographic origin.

[Insert Table 1 here]

In rural areas, participants were drawn from two districts where OFSP is new to the population. Four villages were selected from each district based on ethnicity and distance from the district headquarters. Once selected, a systematic random sample of 40 households was drawn from each village, and the heads or the spouse of the head of the selected households were invited to take part in the experiment. For Kampla, the urban district, two market places were selected where low- and middle-income urban consumers buy their sweetpotatoes for consumption. Consumers were selected randomly in cooperation with the market management committee. Among the participants, around 69% were head of the households and 31% were spouses of the head of the household. About 61% of the household heads make the sweetpotato buying decision while about 23% of the spouses take the buying decision. The rest of the time, the decision is taken by their children.

The Varieties

For each treatment, consumers were exposed to the traditional white variety and two OFSP varieties, one of which was deeper orange in color than the other. These were grown out for use in the study by the National Agricultural Research Organization of Uganda. Those who received nutrition information were told that there was a positive association between the color of the sweetpotato and its beta-carotene content. A fourth variety that is yellow in color was also included, although the yellow varieties are not nutritionally enhanced. Thus, there were four varieties of sweetpotato cultivars in all: i) WHITE (Nakakande variety); ii) YELLOW (Tanzania variety); iii) ORANGE (SPK004/1/1 variety); and iv) DEEP ORANGE (Ejumula variety). Each participant valued all four varieties, and the varieties remained constant across treatments. As noted earlier, each individual participated in only one treatment where the selection to a treatment was randomly assigned.

Experimental Procedure

The experiment followed the following sequence of steps: step-1: sensory acceptability; step-2: provision of nutritional information to appropriate treatment arms; step-3: choice experiment (CE); step-4: demographic module. Participants were organized in groups of four and were randomly assigned among four treatments. Each participant was given UGS500 (about the equivalent of 30 US cents) at the beginning of the experiment for participation, which s/he could keep or spend during the experiment depending on the treatments assigned and choices made. Participants who were assigned in hypothetical and real treatments went through all four steps. Participants who were assigned in real without information went through step-1, step-3, and step-4.

Sensory acceptability

Each participant tasted a portion (30g to 50g) of each cooked sweetpotato variety (simultaneously presented in random order and coded with three figure random numbers on white paper plates). The samples were prepared in a way similar to that normally used by Ugandan households for their own consumption. Fresh sweetpotato roots were sorted to remove diseased and insect damaged ones, peeled and cut into roughly equal sized portions (5 to 10 cm) and boiled until the texture, assessed by a fork, was considered correct for eating. During testing fresh samples of cooked sweetpotato were frequently prepared. The four varieties were scored for a) taste; b) appearance; and c) overall acceptability, using a nine point hedonic scale. The administrator explained the score sheet to participants on a one-to-one basis. The process followed here is similar to that is usually followed in food science for collecting information on consumer acceptance of products (Tomlins et al., 2005, Tomlins et al., 2007). The score sheet used in the experiment is given in Appendix 1.

Nutritional Information

Participants selected for the three treatments with information (treatments 2, 3 and 4) were given nutritional information on OFSP by one administrator. The nutritional message that was given to participants is similar to the one that implementing NGOs were planning to us in OFSP promotion in Uganda. The message is attached in Appendix 2.[7] Respondents who took part in the real treatment without information (treatment 1) did not receive any information. These subjects were asked about whether they had any prior information on OFSP; this information is used as a control variable in the empirical estimation.

[7] We are grateful to Anna-Marie Ball for providing us with this information.

Choice Experiment

All participants then proceeded to the choice experiment and were given a choice sheet that contained seventeen repeated CE questions (see the Appendix 3 for CE scenarios). The administrators worked on a one-on-one basis, and explained instructions to the subjects. In the instructions, we followed Cummings and Taylor (1999), List (2001), and List et al (2006), with necessary changes due to differences in goods and allocation mechanism (see the Appendix 4 for subject instructions). Participants responded to a series of 17 CE questions. Subjects taking part in hypothetical treatments were instructed that "… choices that you will make are hypothetical and no purchase will take place." Subjects assigned to the two real treatments were informed that after completing all CE questions, one number out of 17 would be randomly selected as binding for which actual payment would occur.

Prices of traditional varieties of sweet potatoes were collected from the local market places immediately prior to the experiment. Sweet potatoes in Uganda are usually sold in heaps (supermarkets in Kampala are the exceptions that sell in KGs) where each heap varies from three to five KGs depending on the seasons. In our experiment, we kept the weight of heaps constant at three KGs for all varieties across treatments. The prices of the WHITE variety were varied between UGS500, UGS700, UGS800, and UGS1000. These encompassed the minimum and the maximum prices of traditional sweet potatoes observed in Uganda (again, with the exception of supermarkets in Kampala). For the OFSP for which market price did not exist, we had focus group discussions and local experts' opinions; and prices were varied between UGS300, UGS500, UGS1000, and UGS1200. These were constructed as ±one standard deviation from the minimum and maximum price of the traditional variety.[8] A 'none of these' option, in addition to four products, was also included that acts as a base from which other alternatives are compared (Louviere, 1988).

Ideally, a consumer's valuation of a product depends on various attributes such as taste, appearance, nutritional value etc. However, consideration of all the dimensions simultaneously makes a choice set too large to be manageable. The choice set given to the respondents was prepared by using a fractional

[8] The standard deviation is 208.177. However, in Uganda, the minimum denomination of exchange usually used is UGS50. As a result, the prices were kept in-line with the common denomination of exchange.

factorial design. It is similar to the one used in Lusk and Schroeder (2004), which represents a suitable fraction of all possible combinations of factor levels, and captures the main effects for each factor level. It, in addition, also avoids multicollinearity and ensures that prices of each product are totally uncorrelated with the prices of each of the other three products.

Demographic Module

The experiment was followed by a survey that collected information on income, demography, nutritional information and awareness, consumption, production, buying and selling behavior. These variables were then used to provide additional controls in the estimation of their willingness to pay.

The Econometric Model

To estimate consumers' valuation for different varieties of sweetpotato, a universal logit model that estimates the impact of prices on four different varieties – WHITE, YELLOW, ORANGE, and DEEP ORANGE sweet potatoes has been estimated. The reference alternative consists of "none of these"- that means, not choosing any of the four varieties.

In the universal logit model, the ith subject's utility, if s/he chooses *j* variety of sweetpotato, is given by

$$(3) \qquad V_{ij} = b_j + \sum_{k=1}^{5} a_{jk} P_{ik} + c_i' X_i + \varepsilon_{ij}$$

Here j=1…5, k=1…5, b_j is variety specific constant, a_{jk} is the effect of kth variety's price on the utility of the jth variety, P_{ik} is the kth variety price for the subject i, X_i is a vector of observed subject specific characteristics including variables such as subject's age, schooling, income and other household characteristics. Note that unlike multinomial logit, both the subject specific characteristics and choice specific characteristics are allowed here to affect the utility of all choices. A subject chooses V_{ij} if $V_{ij} > V_{ik}$ for all other k possible choices. It is assumed that ε_{ij} is independent and follows a type 1 extreme value distribution given by $exp[-exp(-\varepsilon_{ij})]$ which assumes that the omission of an irrelevant choice set should not change the parameter estimates.

Unlike multinomial logit (MNL), the universal logit model specified above relaxes the MNL cross elasticity properties by including attributes of competing alternatives in the utility function for all alternatives in the choice set (McFadden, Train and Tye, 1978). To test the independence of irrelevant alternatives (IIA) assumption, the appearance of significant cross-effects for the effect of alternative *k* would imply that the utility of an alternative depends on the attributes of other alternative(s), and therefore IIA assumption no longer holds. Though not the central focus, an examination of the results shows that cross-effects of some of the attributes of interest, such as price and taste, are different from zero, and therefore, the selection of universal logit over MNL is justified[9].

Since the IIA property is violated, we have estimated a multinomial probit (MNP) model that does not assume errors are independently distributed across alternatives. The probability that subject *i* chooses alternative j is given by:

(4) $$P_{ij} = \int_{-\infty}^{\varepsilon_j + V_j - V_k} \ldots \int_{-\infty}^{\infty} \ldots \int_{-\infty}^{\varepsilon_j + V_j - V_J} f(\varepsilon) d\varepsilon_j \ldots d\varepsilon_1$$

where *J* are the alternatives and $f(\cdot)$ is a *J*-variate normal density function with mean zero and $J \times J$ covariance matrix Σ (Louviere et al 2000, Lusk and Schroeder 2004). As we will see in the next section, the estimated WTP and marginal WTP based on MNP model are not statistically different from those obtained from the universal logit model.

As described in the Experimental Design Section, we have repeated observations, seventeen to be precise, per subject. It is likely that errors are correlated over repeated observations for a given subject and within-subject clustering is needed. In the universal logit estimation, we therefore treated each

[9] Models that relax the IIA assumption are discussed in Results Section.

subject as a cluster.[10] In addition, we have estimated fixed-effects logit model for panel data (Chamberlain 1980) in which the probability that alternative *j* is chosen by subject *i* is give by:

(5) $$P_{ij} = \frac{\exp(\mu V_{ij})}{\sum_{j=1}^{J} \exp(\mu_i V_{ij})}$$

where μ is a positive scale parameter.

In estimating WTP and marginal WTP, we are also concerned with the probable heteroskedasticity since error variance may not be constant across subjects or alternatives. To account for possible heteroskedasticity correction, we have estimated a heteroscedastic conditional logit model[11] in which the probability that alternative *j* is chosen by subject *i* is give by (Hole 2006):

(6) $$P_{ij} = \frac{\exp(\mu_i V_{ij})}{\sum_{j=1}^{J} \exp(\mu_i V_{ij})}$$

Where μ_i is scale parameter. It is a function of individual characteristics that influence the magnitude of the scale parameter and therefore the error variance. Here μ_i is parametrised as $\exp(X_i\gamma)$ where X_i is a vector of observed subject specific characteristics as described above. A test for γ=0 is a test for the error variance being constant across subjects. As we will see in the result section, Lagrange multiplier test for heteroscedasticity reveals that the presence of heteroscedasticity cannot be rejected.

Finally we estimate a mixed logit model[12] which is free of any restrictive assumptions such as IIA and allows taste parameters to vary in the population. We modify equation (1) to express the utility that subject *i* gets from choosing alternative *j* is given by:

[10] However, controlling for clustering increases standard errors, especially for regressors that are highly correlated with the cluster (Cameron and Trivedi 2009, pp.306-307).
[11] This model is also referred to as the parametrised heteroscedastic multinomial logit model (Hensher et at., 1999).
[12] This model is also referred to as the random parameter logit model (Lusk and Schroeder 2004).

(1') $U_{ij} = \mathbf{x}_{ij}^{'}\beta_i + \varepsilon_{ij}$

(7) $\beta_i = \beta + \mathbf{z}_i + \eta_i$

where $\mathbf{x}_{ij}$ is the full vector of observed characteristics including the attributes of alternatives described above, ε_{ij} are iid extreme value, $\mathbf{z}_i$ is observed data and η_i is an additional error term. The unconditional probability that subject *i* chooses alternative *j* is given by (Hensher et al 2005):

(8) $P_{ij} = \int_{\beta_i} L_{ij}(\beta_i | \mathbf{x}_i, \eta_i) f(\eta_i | \mathbf{z}_i, \mathbf{\Omega}) d\eta_i$

In estimating the mixed logit model, the alternative-specific constants are assumed to be independently normally distributed in the population while other coefficients including price are assumed fixed. The model has been estimated by using maximum simulated likelihood (Train 2003, Hole 2006).

Demographic variables such as family size, number of children under the age of five years, and the presence of pregnant women and breastfeeding mothers can have significant influence on household consumption decision (Pollak and Wales 1981). Such variables have been included in the WTP analysis to see the conditional preferences for OFSP.

[Insert Table 2 here]

Table 2 provides summary statistics on the demographic characteristics of the respondents in the four different treatment arms, as well as information on their incomes and any prior information on OFSP. It is clear that there is no significant difference among four different treatments in respect of individual characteristics. This ensures that there was no systematic bias in subject selection among treatments, and that the random assignment of subjects on four different treatments was properly done.

Results

Table 3 reports parameter estimates of full sample and all four treatments estimated by the universal logit model. Only the variety specific constants (b_j of equation 3) and own-price effects (a_j of equation 3) are reported in Table 3.

[Insert Table 3 here]

We have repeated observations, seventeen to be precise, per subject, which we treated as a cluster. It is likely that errors are correlated over repeated observations for a given individual and within-individual clustering is needed. However, controlling for clustering increases standard errors, especially for regressors that are highly correlated with the cluster (Cameron and Trivedi 2009, pp.306-307).

The test for parameter equality across treatments, (given by $-2(LL_j - \sum LL_i)$, which is distributed as χ^2 with *K(M-1)* degrees of freedom, where LL_j is the log likelihood value for the full sample, and LL_i is the log likelihood value for each of the treatments, *K* is the number of restrictions, 17, and *M* is the number of treatments, 4 (Lusk and Schroeder 2004, Louviere, Hensher and Swait 2000) is strongly rejected (χ^2=1959.9; p<0.01). Hence, in the rest of the paper, we report results based on the four separate treatments, and not those for the pooled full sample.

Second, to test the validity of IIA assumption, we implement Hausman's specification test, which suggests that the omission of an irrelevant choice set should not change the parameter estimates (Hausman and McFadden, 1984). The test rejects the assumption of IIA.[13]

How much consumers value a particular variety of sweetpotato *j* is obtained as the ratio of variety specific constant to the price coefficient ($-b_j / a_j$). Table 4 reports the willingness-to-pay (WTP) for

[13] For the full sample, the chi2 (37)=(b-B)'[(V_b-V_B)^(-1)](b-B)=65.47, prob>chi2=0.0027. The test statistics for others are available upon request.

each variety calculated from the parameters (reported in Table 3) estimated by the universal logit model (Equation 3). The reported WTPs are for one KG of sweetpotato (Table 4). Standard errors of WTP are generated through parametric boot strapping method and reported in Table A1 in Appendix 5.

The *marginal* willingness-to-pay for a particular OFSP *j* versus traditional white variety *k* is calculated as the difference in willingness-to-pay between *j* and *k* ($-b_j / a_j + b_k / a_k$). Table 4 also reports these marginal WTP estimates, while the corresponding boot-strapped standard errors are in Table A2.

[Insert Table 4 here]

Willingness to pay (WTP) for OFSP in the absence of nutrition information

The WTP estimates obtained in the treatment "real without information" suggest that relative to the familiar white varieties, there is no difference in the willingness to pay for deep orange sweet potato. This is however not true for the other orange variety, for which consumers appear to be willing to pay less than they would for the white variety; suggesting that it's sensory characteristics may adversely affect consumers' valuation. In addition, the yellow variety commands a statistically significant and substantial discount of nearly 30%.. These results suggest that in the absence of an information campaign, new varieties including OFSPs, if accepted by farmers, may suffer a price disadvantage in the market, and there is clearly no premium for the orange taste either.

The impact of nutrition information

The provision of nutrition information translates into a premium for the orange varieties between treatments. The difference in WTP between the two real treatments—with and without information—indicates an increase of UGS 32 per kg and UGS 126 per kg, respectively, both of which are statistically significant. With knowledge of the nutritional value, there is a substantial premium for the deep orange varieties relative to white, which is also significant, unlike the case when no information was provided. The WTP for deep orange varieties is nearly 40% higher than that for the white.

These premia are in line with the findings of McGuirk et al. (1995) and Kinnucan et al. (1997), who find a significant impact of health information on food demand in the United States.[14] The magnitude of the premium for deep orange varieties when nutrition information is provided is line with those found in other studies: a 25-50% premium for non-GMO foods are reported in Europe and Japan, although the magnitudes are far more modest in the United States (see for example Li, McCluskey and Wahl, 2004).

Nevertheless, given the developing country setting of the study, the premia for nutrition information appear high, given the relatively limited purchasing power of most study participants, and the salience of a staple food in average budgets in countries such as Uganda. One explanation may be that the nutritional information was given in a one-to-one setting; making it the most effective and perhaps the most costly form of communication. This might have biased upward the size of the impact due to nutritional information and may well have been lower had other forms of communication been used.

Has one-to-one interaction between subjects and experimenter resulted in upward bias? Our assumption was that the subjects' expected experiment objectives are orthogonal to the true objectives and predictions, and they do not plausibly imply actions on behalf of subjects. However, looking at the results, the experimenter demand effects cannot be entirely ruled out. However, we needed to weigh between the experimental objectives and possible limitations. Eliciting valuation in rural communities in developing countries through choice experiment or similar mechanisms requires one-to-one interaction between experimenter and subjects. The low level of formal schooling (less than seven years in our sample, see Table 2) makes it extremely difficult to minimize experimenter's presence. This does not necessary mean that the experimental results are confounded. The nutritional information campaign designed by NGOs to promote OFSP involves face-to-face communication. Therefore, the experimental setting mimics the actual strategy that will be followed in the future.

[14] Since it was a between-subject design, there was no scope to see how subjects' valuation for OFSP changes once information is given.

However, the impact of prior information is negative and significant (see Table 5), which is puzzling. Since our data does not have any further details on the sources and nature of prior information received by subjects, the issue remains underexplored. However, a simple comparison of the mean WTP between two groups, those who received prior information and those who did not in treatment 3 shows that the latter group is willing to pay more than 7% higher for the deep orange variety of OFSP.

The magnitude of hypothetical bias

The extent to which WTP for new products, and the marginal WTP for nutrition information, can be accurately assessed in a hypothetical setting can be seen by comparing the magnitudes of WTP in treatments (2) and (3) in Table 4. It is evident that in the absence of a cheap-talk script, hypothetical bias is large: on average, participants overstated their WTP by a factor of above 2 in hypothetical scenarios compared to real scenarios. This supports the findings reported in List and Gallet (2001). In addition, the *marginal* WTP estimates from the hypothetical choices are also overstated. As might be expected, the degree of hypothetical bias for white varieties is minimal, since this is the product with which consumers are familiar. Note that unlike the case in most hypothetical elicitation experiments, consumers in Uganda had an opportunity to taste the three products that they were being asked to assess. So the difference in the 'real' and 'hypothetical' arms cannot be attributed to their exposure to the product, but entirely to the fact that in the real treatment, respondents had to make a purchase, but in the hypothetical arm, they did not have to do so.

The mitigation of hypothetical bias through cheap talk

Turning to the effectiveness of cheap talk in mitigating hypothetical bias, the results suggest that although the use of a cheap talk script does result in a reduction in the magnitude of the willingness to pay, the bias remains substantial. This finding is of interest because unlike most other cheap talk scripts, such as those used by Cummings and Taylor (1999) and List (2001) which explicitly indicate the direction of bias, the cheap talk script used in this study was deliberately neutral in its wording. Nonetheless the cheap talk had the desired effect of lowering hypothetical bias, although it did not eliminate it. For example, while the WTP for deep orange in the hypothetical arm was 750 UGS/kilo, more than double the UGS 357 in the real arm, with cheap talk the WTP estimates drop to UGS 553/kilo, considerably lower than 750, but still much higher than the 357. Upward biases are also seen in the estimated *marginal* willingness to pay for orange and deep orange varieties as well, although once again these biases are lower than was the case in the hypothetical scenario without using a cheap talk script.

The correlates of willingness to pay

To examine how the taste, income and demographic factors influence WTP, Table 5 presents the estimated coefficients of the universal logit model for the real treatment with information.[15]

[Insert Table 5 here]

Though the income coefficient is positive, it is not significant. Since sweetpotato is one of the prime staple foods for the participants in this study, this is not an unexpected result.[16] Taste factors are also important: all own-taste and most cross-tastes coefficients are significant (Table 5). These also provide a justification for the inclusion of a consumer acceptance taste test prior to the CE, although collinearity problems precluded the inclusion of all the sensory variables[17]. Urban/rural differences in WTP and marginal WTP are captured in two rural district dummies. Rural households have a lower WTP for the traditional variety of sweetpotato but have a higher WTP for varieties with higher β-carotene content sweetpotatoes (based on real treatment with information).

Results obtained from alternative models

Parameter estimates (variety specific constant and own-price effects) and the associated WTP and MWTP obtained from alternative models that do not put IIA restrictions (multinomial probit model,

[15] We present the parameter estimates only of one of the treatments; the coefficients in the other treatments have by and large the same sign. The full set of estimates is available from the authors on request.

[16] To see if alternative measure of income such as land ownership has any impact, we replaced income with land. The results are reported in Table A3 in Appendix. For two orange varieties, land-ownership has positive and significant effect.

[17] The pair-wise correlation coefficient between taste and overall acceptability for each of the four samples is a high 0.9.

and mixed logit model), that takes the repeated nature of the data into account (fixed-effects logit model), that corrects for possible heteroscedasticity (heteroscedastic conditional logit model), and that allows taste parameters to vary across varieties are presented in Table A4 in Appendix. The results show that WTP and marginal WTP obtained from alternative models are not statistically different from those obtained from the universal logit model. However, the maximum likelihood test conducted after the estimation of heterscedastic conditional logit model rejects the assumption that error variances are constant across subjects. Turning to the mixed logit results, except for the deep-orange, the variety-specific random parameter estimates are not statistically significant. However, for the deep-orange variety, the random parameter estimate suggests the existence of heterogeneity over the sampled population.

Preference consistency

In its simplest form, a WARP violation occurs if a subject chooses a particular variety of sweetpotato (e.g., WHITE) in one scenario when another variety of sweetpotato (e.g., ORANGE) is less expensive, but chooses ORANGE in a different scenario when WHITE was less expensive. We had 17 choice scenarios; each subject went through all the 17 choice scenarios and made her/his choice in each of the scenarios. Around 30% of the subjects violated the WARP at least in one circumstance. This is similar to what reported in List et al (2006).

To see if WARP violation tends to increase with the increasing number of scenarios, we looked at the correlation between choice scenarios and WARP violation, which is 0.18. This indicates the presence of survey fatigue from the survey administrators or subjects' part. To see if violation has any systematic link with the administrators' characteristics, we looked at the number of violations occurred with each of the six administrators. We had six administrators who were locally recruited and trained by us. However, we have not found any systematic relationship between administrators' observed characteristics such as gender (we had three male and three female experimenters), age or education (all of them were recent graduates from local universities in economics or computer sciences). To explore further, we estimated a probit model of WARP violation on subjects observed characteristics that included gender, education and income and other demographic characteristics. Again, we did not find any systematic relationship between subjects' observed characteristics and WARP violations.

In terms of the violations by treatments, the highest number WARP violation occurred in the hypothetical treatment with cheap talk (29.24%) and the lowest number of WARP violation occurred in real treatments (13.08%). List et al (2006) reports a similar result from a choice experiment that they conducted in the USA. In their experiment, the proportions of subject with inconsistent preference were 24.5% and violations increased in hypothetical treatment with cheap talk (33.9%), which is slightly higher than the number of violations occurred in the current experiment. Again, this might add further question to the validity of cheap talk, which may reduce hypothetical bias but introduces a new bias into subject's decision making.

This may suggest that using as many as 17 choice sets and "cheap talk" may be problematic; this is an area for further research.

Conclusions

We used real money and real products to compare the willingness to pay for sweetpotatoes that are both traditional (white and yellow) and that are biofortified (orange and deep orange), and compared these with results constructed from hypothetical scenarios. We also relied on methods from food science to enable consumers to taste the products that they would be asked to value.

Our results confirm the presence of hypothetical bias reported in literature. It is therefore important to introduce and work with the real product in order to elicit accurate estimates of the WTP and marginal WTP for biofortified crops in developing country settings.

The introduction of a cheap talk script does result in a significant reduction in valuations, even when the script does not mention the direction of possible bias. However, the estimated WTP and marginal

WTP are higher than those obtained in the real treatment, suggesting that while the bias is reduced it is not eliminated. The additional expense of working with real incentives and products appears justified.

Turning to the scenarios using the real product, our results for Uganda, a key target country for the orange-fleshed sweetpotato suggest that in the absence of a promotional campaign, OFSP varieties, on an average, are likely to compete on par with the traditional white varieties in the market. To the extent that sweetpotato is produced and consumed on-farm, provided the agronomic properties are acceptable to farmers, there may not be any significant discount in the market. Our post-experimental inquiry reveals that OFSP that are currently sold in the market are sold at a price similar to the traditional white varieties. However, the supply of OFSPs remains very limited at this stage and they are often not sold separately- rather mixed with traditional varieties.

The impact of nutrition information is substantial. When informed about the nutritional value of the OFSP, consumers are willing-to-pay a premium, and the size of the premium is higher for the deep orange than for the orange; the deep orange has more beta-carotene than the orange. However, given the one-to-one communication, the possibility of the experimenter demand effect on the subjects cannot be entirely ruled out.

This paper represents perhaps one of the few examples where choice experiments have been conducted in a developing country setting, using rural and urban consumers. Our results provide a validation of the use of choice experiments in developing country settings, although the percentage of respondents who exhibited inconsistent switches in preferences is somewhat high, especially in hypothetical treatment with cheap talk.

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Tables and Figures

Figure 1: The Field Design

	Without Nutrition Information	With Nutrition Information
Real	(1)	(2)
Hypothetical, no cheap talk		(3)
Hypothetical, with cheap talk		(4)

Table 1: Distribution of Participants According to Treatments and Geographic Origin

Region	District	Without information	With information			Total
		REAL (1)	REAL (2)	HYPO (3)	CHEAP TALK (4)	
Rural	Kamuli	41	37	34	41	153
	Luweero	40	40	44	32	156
Urban	Kampala	40	38	40	40	158
Total		**121**	**115**	**118**	**113**	**467**

Table 2: Variable Definitions and Summary Statistics

Variable	Definition	Full Sample	Real, without information	Real	Hypothetical	Cheap Talk
				With information		
Taste	Participants' relative preference among the four varieties					
White	% of participants who preferred the white variety most	9.24	12.61	10.68	7.96	5.66
Yellow	% of participants who preferred the yellow variety most	26.10	22.52	22.33	23.89	35.85
Orange	% of participants who preferred the orange variety most	13.16	14.41	11.65	13.27	13.21
Deep orange	% of participants who preferred the deep orange variety most	51.50	50.45	55.34	54.87	45.28
Demography and Income						
Gender	% of male	0.455	0.423	0.505	0.460	0.434
		(0.006)	(0.011)	(0.012)	(0.011)	(0.012)
Education	Years of schooling	6.393	5.973	6.735	6.463	6.444
		(0.041)	(0.074)	(0.090)	(0.161)	(0.082)
Family Size	Number of members in the household	6.136	5.865	6.282	6.354	6.047
		(0.056)	(0.089)	(0.087)	(0.011)	(0.077)
Children under 5	Number of children under the age of five	1.388	1.351	1.485	1.274	1.453
		(0.015)	(0.035)	(0.029)	(2844.921)	(0.027)
Pregnant/Brest feeding	Number of pregnant/ breast-feeding women in the household	0.402	0.441	0.359	0.310	0.500
		(0.007)	(0.015)	(0.012)	(0.011)	(0.014)
Income	Household income in UGS/year	83282	81685	94073	80333	93320
		(81281)	(135195)	(87667)	(83453)	(77942)
Prior Information on OFSP	% of participants who received information on OFSP	0.383	0.288	0.272	0.416	0.557
	prior to the experiment	(0.006)	(0.010)	(0.011)	(0.011)	(0.012)
Kampala	# of observations from Kampala	2686	680	646	680	680
Kamuli	# of observations from Kamuli	1,955	527	425	493	510
Luweero	# of observations from Luweero	2,720	680	680	748	612

Standard errors are in parentheses.

Table 3: Parameter Estimates – Universal Logit Model

Variety specific constant	Full sample		Real without Information (1)		Real with Information (2)		Hypothetical, no cheap talk (3)		Hypothetical, with Cheap Talk (4)	
White	9.344	(0.616)	16.786	(1.625)	5.660	(1.411)	5.825	(1.801)	15.904	(1.965)
Yellow	6.854	(0.516)	5.500	(1.064)	3.435	(1.207)	9.994	(1.628)	11.548	(1.370)
Orange	7.196	(0.493)	5.001	(1.061)	5.547	(0.987)	10.283	(1.582)	11.662	(1.339)
Deep orange	7.298	(0.466)	6.421	(1.114)	7.110	(0.856)	9.021	(1.550)	11.901	(1.234)
Own-price effects										
White	-0.010	(0.001)	-0.024	(0.002)	-0.008	(0.001)	-0.006	(0.001)	-0.019	(0.002)
Yellow	-0.007	(0.000)	-0.011	(0.001)	-0.009	(0.001)	-0.006	(0.001)	-0.010	(0.001)
Orange	-0.006	(0.000)	-0.009	(0.001)	-0.008	(0.001)	-0.005	(0.001)	-0.010	(0.001)
Deep orange	-0.005	(0.000)	-0.009	(0.001)	-0.007	(0.000)	-0.004	(0.000)	-0.007	(0.001)
Log Likelihood	-5124		-872		-985		-1368		-919	
No. of observations	6640		1760		1568		1728		1584	

Numbers in the parentheses are standard errors

Table 4: Willingness-To-Pay (WTP) and Marginal Willingness-To-Pay (WTP) for OFSP (UGS/Kg)

	Real without Information (1)	Real with Information (2)	Hypothetical (3)	Hypothetical with Cheap Talk (4)
Total WTP				
White	237	250	331	274
Yellow	168	123	574	392
Orange	189	221	631	394
Deep Orange	232	357	750	553
Marginal WTP				
Yellow vs White	-68 (29%)	-126 (50%)	243 (73%)	118 (43%)
Orange vs White	-47 (20%)	-28 (11%)	301 (91%)	120 (44%)
Orange vs Yellow	21 (11%)	98 (44%)	58 (9%)	2 (1%)
Deep Orange vs White	-5 (2%)	108 (43%)	419 (127%)	279 (102%)
Deep Orange vs Yellow	63 (27%)	234 (66%)	176 (23%)	161 (29%)
Deep Orange vs Orange	42 (18%)	136 (38%)	118 (16%)	159 (29%)

WTP values for 1 KG of sweetpotato

Table 5: Universal Logit Estimates – Real Treatment with Information

Coefficient	White Variety	Yellow Variety	Orange Variety	Deep Orange Variety
Price of white sweetpotato	-0.00756***	-0.00142	0.000183	0.0000686
	(0.0014)	(0.0012)	(0.0009)	(0.0006)
Price of yellow sweetpotato	0.000198	-0.00929***	-0.00165***	-0.000227
	(0.0007)	(0.0009)	(0.0005)	(0.0003)
Price of orange sweetpotato	-0.000187	0.00106	-0.00835***	-0.00133***
	(0.0007)	(0.0007)	(0.0008)	(0.0003)
Price of deep orange sweetpotato	-0.000825	-0.000432	-0.000668	-0.00663***
	(0.0007)	(0.0006)	(0.0005)	(0.0004)
Gender	1.188***	-0.312	0.198	0.174
	(0.4400)	(0.2700)	(0.2500)	(0.2100)
Education	0.0879	0.126***	-0.0122	0.0666**
	(0.0600)	(0.0410)	(0.0380)	(0.0330)
Family size	-0.0485	-0.0205	-0.133***	-0.0256
	(0.0750)	(0.0520)	(0.0500)	(0.0410)
Children under five	0.356	0.139	0.409***	0.338***
	(0.2700)	(0.1500)	(0.1300)	(0.1100)
Pregnant/Breast feeding mother	-0.127	-1.191***	-1.024***	-1.271***
	(0.4500)	(0.2800)	(0.2500)	(0.2100)
IncomeX10^5	0.0109	0.00954	0.0212	0.00723
	(0.0190)	(0.0180)	(0.0180)	(0.0160)
Prefer yellow variety	-1.395**	2.681***	2.867***	1.075***
	(0.5400)	(0.4900)	(0.4900)	(0.4100)
Prefer orange variety	-1.717**	-0.326	2.091***	-0.635
	(0.7100)	(0.5400)	(0.5100)	(0.4400)
Prefer deep orange variety	-4.690***	-0.373	1.001**	1.487***
	(0.7300)	(0.4300)	(0.4100)	(0.3500)
Prior information on OFSP	-2.257***	-1.468***	-0.989***	-0.936***
	(0.6900)	(0.3500)	(0.3100)	(0.2700)
Kamuli district	-1.827**	2.138***	0.895**	-0.0143
	(0.8600)	(0.4700)	(0.4100)	(0.3500)
Luweero district	-0.249	1.675***	0.773**	-0.273
	(0.5400)	(0.4100)	(0.3800)	(0.3200)
Constant	5.660***	3.435***	5.547***	7.110***
	(1.4100)	(1.2100)	(0.9900)	(0.8600)
Observations	1568			
Log Likelihood	-984.567			

Standard errors in parentheses *** p<0.01, ** <0.05, * p<0.1

Appendix 1

Hedonic scale used by consumers for the acceptability (appearance, taste and overall) for cooked sweetpotato

Participant Number ____

Sample Code ____

Please taste the four samples on the plate in front of you. Each sample is identified by a code. Please tick each box according to how acceptable you find each sample for appearance, taste and overall acceptability

	Appearance	Taste	Overall acceptability
Like extremely	☐	☐	☐
Like very much	☐	☐	☐
Like moderately	☐	☐	☐
Like slightly	☐	☐	☐
Neither like nor dislike	☐	☐	☐
Dislike slightly	☐	☐	☐
Dislike moderately	☐	☐	☐
Dislike very much	☐	☐	☐
Dislike extremely	☐	☐	☐

Comments

Appendix 2

Nutrition message given to selected participants (Hypothetical, Cheap Talk and Real with information)

Orange fleshed sweet potato can help improve health because it is a good source of vitamin A. Without vitamin A we can become more susceptible to blindness, infection, reduced growth and development of our bodies, less healthy skin and even lead to death, in particular children. We all need vitamin A but young children especially need it because their bodies are rapidly growing. Pregnant and nursing mothers provide food for growing babies, so they too should have diets rich with vitamin A.

Good sources of vitamin A in the diet include fruits and vegetables, especially those that are deep orange or dark green in colour. Orange fleshed sweetpotato is an excellent source. Vitamin A can also be found in dairy products, liver and egg yolks. White or yellow fleshed sweetpotato are poor sources of vitamin A.

Appendix 3

Choice experiment scenarios for three KGs of sweetpotato cultivars

Scenario	White Fleshed	Yellow Fleshed	Orange Fleshed	Deep Orange Fleshed
1	500	300	300	300
2	800	1000	300	1000
3	1000	1200	300	1200
4	700	500	300	500
5	700	1200	1000	300
6	1000	1000	500	300
7	800	500	1200	300
8	500	1200	1200	1000
9	1000	300	1200	500
10	500	1000	1000	500
11	700	1000	1200	1200
12	700	300	500	1000
13	800	300	1000	1200
14	800	1200	500	500
15	1000	500	1000	1000
16	500	500	500	1200
17	300	300	300	300

Appendix 4: Subject instructions

Subject Instructions for the "Real" Treatment
Now you have the opportunity to buy one of the four products that you just tested. They are arranged in 17 different scenarios. We would like you to make a choice in each scenario described below. In each scenario, there are four products that you just tested, and you may choose any of them. Alternatively, you may choose none of them.

Once you have made your choice for each scenario, I will pick a number from the box that contains all scenario numbers (show them the box and the numbers inside). Each number has an equal chance to be picked. The number that I will pick will be the binding scenario. Only one of your choices will be binding. For example, if I pick 17, then the scenario number 17 will be binding. Depending on the choice that you have made, you will purchase the product or no purchase will be required if you have made "none of these" option in the binding scenario.

Do you have any questions?

Subject instructions for the "Hypothetical" Treatment
Now imagine that you have the opportunity to buy one of the four products that you just tested. They are presented in 17 different scenarios. We would like you to make a choice in each scenario as if you were actually facing them in real life. In each scenario, there are four products that you just tested, and you may choose any of them. Alternatively, you may choose none of them. Note that all these choices that you will make are hypothetical and no purchase will take place.

Cheap talk script (CT 1999, List 2001, List et al 2006)
Before you make your choices, I want to talk to you about a problem that we have in studies like this one. As I told you a minute ago, this is a hypothetical choice – not a real one. No one will actually pay money at the end. But, I also asked you to choose as though the result would involve a real cash payment. And that's the problem.

In most studies of this kind, folks seem to have hard time doing this. They act *differently* in a hypothetical setting, where they don't really have to pay money, than they do in a real purchase, where they really could have to pay money. For example, in a recent study, several different groups of people bid in an auction. Payment was hypothetical for these groups, as it will be for you. No one had to pay money if they won the auction. The results of these studies showed that consumers' were stating their willingness to pay very differently in hypothetical setting than in real situations where payments need to be made.

We call this a "hypothetical bias." "Hypothetical bias" is the difference that we continually see in the way people respond to hypothetical scenarios as compared to real scenarios – just like the example presented above.

In the real auction, where people knew they would have to pay money if they actually own, people put their bid differently.

How can we get people to think about their choices in a hypothetical situation like they think in a real situation, where a person will really have to pay money? How do we get them to think about what it means to really dig into their pocket and pay money, if they are not going to have to do it?

Let me tell you why I think that we continually see this hypothetical bias, why people behave differently in a hypothetical situation than they do when in a real situation. I think that when we behave in a hypothetical situation we place our best guess of what we really like to do. But, when the choice is real, and we would actually have to spend our money if we win, we think a different way: if I spend money on this, that's money I don't have to spend on other things…we act in a way that takes into account the limited amount of money we have… This is just my opinion, of course, but it's what I think may be going on in hypothetical situations.

So, if I were in your shoes, and I was asked to make several choices, I would think about how I feel about spending my money this way. When I got ready to choose, I would ask myself: if this were a real situation, and I had to pay $X if I win, do I really want to spend my money this way?

Please keep this in your mind when making your choices.

Table A1. Mean WTP (for 1KG in UGS) and Bootstrap Standard Error

	Observed WTP	Bootstrap Std. Err.	z	P>z	95% Confidence Interval	
Full Sample						
White	314.71	17.228	18.27	0.00	280.943	348.478
Yellow	336.15	22.602	14.87	0.00	291.853	380.455
Orange	369.31	24.284	15.21	0.00	321.716	416.909
Deep Orange	466.24	35.742	13.04	0.00	396.186	536.295
Real without information						
White	236.78	15.025	15.76	0.00	207.333	266.232
Yellow	168.43	32.221	5.23	0.00	105.273	231.578
Orange	189.38	32.847	5.77	0.00	124.998	253.757
Deep Orange	231.72	40.317	5.75	0.00	152.701	310.744
Real with information						
White	249.69	69.480	3.59	0.00	113.505	385.868
Yellow	123.26	44.909	2.74	0.00	35.235	211.277
Orange	221.47	38.824	5.70	0.00	145.372	297.564
Deep Orange	357.33	34.837	10.26	0.00	289.052	425.615
Hypothetical						
White	330.79	72.416	4.57	0.12	188.859	472.729
Yellow	573.81	67.237	8.53	0.00	442.025	705.594
Orange	631.47	85.860	7.35	0.00	463.182	799.753
Deep Orange	749.91	152.578	4.91	0.00	450.854	1048.961
Cheap Talk						
White	273.85	28.324	9.67	0.00	218.335	329.365
Yellow	391.95	59.475	6.59	0.00	275.382	508.522
Orange	393.57	50.360	7.82	0.00	294.864	492.275
Deep Orange	552.66	52.095	10.61	0.00	450.553	654.766

Results are based on 100 replications

Table A2. Marginal WTP (for 1KG in UGS) and Bootstrap Standard Error

	Hypothetical			Hypothetical with Cheap Talk			Real with Information			Real without Information		
Yellow vs White	243.02	(75.60)	*	118.10	(50.29)	*	-126.43	(41.40)	*	-68.36	(33.16)	*
Orange vs White	300.67	(83.99)	*	119.72	(50.29)	*	-28.22	(42.40)		-47.40	(34.73)	
Orange vs Yellow	57.65	(71.13)		1.62	(45.80)		98.21	(51.66)		20.95	(34.25)	
Deep Orange vs White	419.11	(165.06)	*	278.81	(59.81)	*	107.80	(46.31)	*	-5.06	(35.39)	
Deep Orange vs Yellow	176.09	(137.62)		160.71	(71.87)	*	234.23	(31.38)	*	63.30	(40.83)	
Deep Orange vs Orange	118.44	(133.71)		159.09	(49.84)	*	136.02	(39.67)	*	42.34	(32.92)	

* significant at 5% or better

Table A3: Universal Logit Estimates – Real Treatment with Information, land ownership instead of income

Coefficient	White Variety	Yellow Variety	Orange Variety	Deep Orange Variety
Price of white sweetpotato	-0.00761***	-0.00145	0.000179	0.0000722
	(0.0011)	(0.0012)	(0.00084)	(0.00054)
Price of yellow sweetpotato	0.000216	-0.00932***	-0.00164***	-0.000226
	(0.00058)	(0.00076)	(0.00053)	(0.00031)
Price of orange sweetpotato	-0.000184	0.00106	-0.00836***	-0.00136***
	(0.00060)	(0.00067)	(0.00069)	(0.00032)
Price of deep orange sweetpotato	-0.000798	-0.000445	-0.000712	-0.00667***
	(0.00066)	(0.00056)	(0.00052)	(0.00043)
Gender	1.290***	-0.356	0.0811	0.0398
	(0.50)	(0.28)	(0.25)	(0.21)
Education	0.113**	0.130***	-0.000546	0.0656**
	(0.047)	(0.037)	(0.035)	(0.028)
Family size	-0.0212	-0.0271	-0.156***	-0.0390
	(0.084)	(0.052)	(0.047)	(0.045)
Children under five	0.307	0.122	0.390***	0.306***
	(0.26)	(0.16)	(0.13)	(0.12)
Pregnant/Breast feeding mother	-0.323	-1.141***	-0.919***	-1.157***
	(0.48)	(0.28)	(0.25)	(0.20)
Land ownership	-0.0152	0.0273	0.0692**	0.0625**
	(0.044)	(0.029)	(0.028)	(0.025)
Prefer yellow variety	-1.389**	2.678***	2.818***	1.031**
	(0.56)	(0.49)	(0.48)	(0.42)
Prefer orange variety	-1.688***	-0.355	2.040***	-0.742*
	(0.57)	(0.55)	(0.51)	(0.44)
Prefer deep orange variety	-4.765***	-0.421	0.915**	1.451***
	(0.82)	(0.43)	(0.42)	(0.39)
Prior information on OFSP	-2.422***	-1.501***	-0.980***	-0.889***
	(0.57)	(0.36)	(0.32)	(0.27)
Kamuli district	-1.691*	2.173***	0.975**	-0.0149
	(0.93)	(0.47)	(0.40)	(0.33)
Luweero district	-0.0877	1.669***	0.734**	-0.323
	(0.54)	(0.40)	(0.35)	(0.29)
Constant	5.440***	3.488***	5.578***	7.183***
	(1.36)	(1.28)	(0.90)	(0.82)
Observations	1568	1568	1568	1568
Log Likelihood	-957.562			

Table A4: Parameter Estimates from Alternative Models- real treatment with information

	Multinomial Logit	Fixed-effects Logit	Conditional Heteroscedastic Logit	Multinomial Probit	Mixed Logit
Alternative specific constants					
White	5.660	5.660	7.094	3.945	6.529
	(1.411)	(1.411)	(1.722)	(0.424)	(1.635)
Yellow	3.435	3.435	4.248	2.386	3.785
	(1.207)	(1.207)	(1.450)	(0.365)	(1.378)
Orange	5.547	5.547	5.777	3.552	5.488
	(0.987)	(0.987)	(1.293)	(0.305)	(1.164)
Deep Orange	7.110	7.110	8.443	5.013	10.561
	(0.856)	(0.856)	(1.314)	(0.265)	(2.093)
Own-price effects					
White	-0.008	-0.008	-0.008	-0.005	-0.009
	(0.001)	(0.001)	(0.002)	(0.0004)	(0.002)
Yellow	-0.009	-0.009	-0.011	-0.007	-0.011
	(0.001)	(0.001)	(0.002)	(0.0003)	(0.001)
Orange	-0.008	-0.008	-0.010	-0.006	-0.010
	(0.001)	(0.001)	(0.001)	(0.0002)	(0.001)
Deep Orange	-0.007	-0.007	-0.008	-0.005	-0.010
	(0.000)	(0.000)	(0.001)	(0.0001)	(0.003)
Standard deviation parameters					
White					0.443
					(1.268)
Yellow					-0.250
					(0.918)
Orange					0.489
					(0.788)
Deep Orange					3.426
					(1.078)
None					
Log Likelihood	-479.684	-959.370	-1011.578	-475.752	947.950
Number of observations					

Table A5: Willingness-To-Pay (WTP) and Marginal Willingness-To-Pay (WTP) for OFSP (UGS/Kg)-real treatment with information

Observed Willingness-to-pay	Universal Logit	Fixed-effects Logit	Conditional Heterosecdastic Logit	Multinomial Probit	Mixed Logit
White	250	250	283	260	248
Yellow	123	123	133	118	110
Orange	221	221	198	212	187
Deep Orange	357	357	359	350	353
Marginal WTP					
Yellow vs White	-126	-126	-149	-142	-138
Orange vs White	-28	-28	-84	-48	-61
Orange vs Yellow	98	98	65	94	77
Deep Orange vs White	108	108	76	90	105
Deep Orange vs Yellow	234	234	226	232	243
Deep Orange vs Orange	136	136	161	138	166

WTP values for 1 KG of sweetpotato