Eliciting Willingness-to-Pay through Multiple Experimental Procedures: Evidence from Lab-in-the-Field in Rural Ghana

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This paper has the objectives of (a) comparing estimated willingness-to-pay (WTP) across three elicitation mechanisms (a Becker-DeGroot-Marschak [BDM] auction, a kth price auction, and a choice experiment [CE]) and (b) examining how these vary by participation fee. The product under consideration is kenkey *made with nutritious maize, biofortified with vitamin A, which gives it a distinct orange color, in contrast to the white and yellow varieties that are traditionally consumed. We use an experiment consisting of 14 treatment arms, conducted in rural Ghana. Our estimation strategy explicitly accounts for the censored (typically at the market price) nature of the bids in the auctions, and the apparently lexicographic choices of several individuals in the CE. We find no evidence of economically meaningful (defined by the minimum currency unit of five pesewas) differences in WTP (although they may be statistically significant) across elicitation mechanisms, or by participation fee, a result that is in contrast to that found in much of the literature. A secondary finding is that the provision of nutrition information positively and significantly affects the marginal WTP for the new maize.*

Cet article a comme objectif de (a) comparer la volonté estimée de payer parmi trois mécanismes de sollicitation (enchères BDM, enchères K^e prix et expérimentation des choix) et (b) examiner leur variance par droits de participation. Le produit examiné est le kenkey fait de maïs nutritif dont la couleur orange distincte est obtenue grâce à sa teneur plus élevée en vitamine A, en contraste aux variétés blanches et jaunes traditionnellement consommées. Une expérimentation à quatorze groupes de traitements a été menée en Ghana rural. La stratégie d'estimation tient explicitement compte de la nature confidentielle des offres aux enchères (typiquement à la valeur marchande) et des choix apparemment lexicographiques de nombreux individus dans l'expérimentation des choix. Aucune preuve de différences économiques significatives (définie par l'unité de référence de cinq pesewas) à la volonté de payer (qui pourraient tout de même s'avérer statistiquement significatives) parmi les mécanismes de sollicitation ni par droits de participation n'a été trouvée, ce résultat contrastant à ceux présentés dans la littérature. Une deuxième conclusion veut que fournir les informations nutritives affecte considérablement le consentement marginal à payer pour le nouveau maïs.

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INTRODUCTION

There are multiple incentive compatible mechanisms to elicit willingness-to-pay (WTP) for a good, all of which should yield similar magnitudes. However, a substantial experimental literature finds otherwise. For example, Kagel et al (1987), Rutstrom (1998), Noussair et al (2004), and Lusk and Rousu (2006) compare multiple auction mechanisms, such as the second price auction and the Becker-DeGroot-Marschak (BDM) mechanism, and find that there are significant differences in mean WTP. A related literature compares WTP elicited using incentive compatible auctions and choice experiments (CEs). Many (though not all) of the results in these papers (Lusk and Schroeder 2006; Corrigan et al 2009; Gracia et al 2011; Elbakidze et al 2014) suggest that estimated WTP from CEs is markedly different from the auction bids.

These WTP experiments are typically conducted with participants getting a participation fee (Smith 1982). The impact this may have on WTP estimates (or on other outcomes of the experiments) has also been studied in several papers (including Rutstrom 1998; Loureiro et al 2003; Skuza et al 2015). While standard models with quasi-linear preferences would appear to rule out any income effects from these participation fees, several studies, including, for example, Loureiro et al (2003), find that those who got higher endowments typically made larger bids, and suggest that endowments closer to the value of the good may be a good way to reduce overbidding. There could be other behavioral effects that are important especially in experimental settings, so that windfall incomes are perceived differently than non windfall incomes, and this translates into different purchase decisions.[1]

Our paper contributes to both these streams of the literature, and has as its primary objectives: (a) a comparison of consumers' WTP across two auction mechanisms (the BDM mechanism and the kth price auction), and a CE; and (b) understanding if and how these vary by the magnitude of the participation fee offered to respondents. We use an experimental design consisting of 14 treatment arms, conducted in rural Ghana, with consumers making decisions about a staple food. We find that using empirical models apposite to our setting yields estimated mean WTP of comparable magnitude across the three elicitation methods. Also, variations in the participation fee have a negligible role to play in determining WTP. These results emerge once we account for two features specific to the setting: first, censoring of bids, especially at the market price, in the two auction mechanisms, and lexicographic choices made by a subset of individuals in the CE, and second, a recognition that statistically significant differences in WTP may not be economically meaningful if the differences lie within the minimum currency unit (MCU) prevalent in rural Ghana. Thus, our results are quite different from those of early papers such as Lusk and Schroeder (2006); the contrast is less stark when compared with more recent papers, such as Corrigan et al (2009) reviewed in section "Overview of Literature."

The context is provided by an intervention, biofortification, designed to improve the nutritive value of commonly consumed staple foods. A new variety of maize, enriched

[1] A related literature examines and finds differences in behavior depending on whether participants are given a windfall sum or are made to "earn" it by completing some tasks—see, for example, Carlsson et al (2013) in the context of a dictator game and Nalley et al (2005) in the context of sealed bid auctions.

with pro-vitamin A, was developed, but had not yet been released in Ghana. Because this maize was orange in color, in contrast to the more common white and yellow varieties of maize, it was necessary to elicit whether this might sell at a premium or discount in the market, and whether these premia or discounts might be influenced by information about the nutritional value of the new product.

As a secondary objective, therefore, the experiment had additional treatment arms to test the effectiveness of a nutritional message produced for this purpose by Radio Ghana. We find that in the absence of this information, orange maize did not sell at a discount of any economic significance relative to white maize; but information provision turned this into a significant premium in two of the elicitation methods.

We chose the BDM and *k*th price auctions over other auction mechanisms (such as the second price auction) due to their suitability for rural settings. In the BDM mechanism, the respondent bids for an object and wins it if the bid is greater than or equal to a randomly drawn sale price (drawn by the enumerator), and pays the sale price. This elicitation can be conducted one-on-one and is therefore usable not just in central locations but also in household survey contexts. Previous experience in rural settings suggests that difficulties in training respondents on the BDM mechanism can be overcome as they are keen to learn if the new product in question interests them (De Groote et al 2011). In a *k*th price auction, a group of respondents submit sealed bids, and bidders corresponding to the top $(k - 1)$ bids win. They pay a price equal to the *k*th highest bid. Since the *k*th price auction has multiple winners (in contrast with the second price auction), it gives a reasonable probability of winning to bidders with low WTP, thereby keeping them engaged and reducing the possibility that their bids will have a lot of noise (see, e.g., Lusk and Shogren 2007). This auction is also easier to explain to participants than the random *k*th price auction. Finally, in the CE, respondents are presented with a set of alternatives that vary by attributes (including price), and asked to make a purchase decision (including an option not to purchase any of the alternatives). This setting is also familiar to many consumers.

Each of these elicitation mechanisms is detailed later, but we highlight here that in the BDM and *k*th price auctions, it is optimal for participants to put in bids equal to their WTP; and that in the real CE, it is optimal for participants to reveal their true preferences across the choices provided. In all treatments, participants were faced with a real product, including the novel (biofortified) one, limited quantities of which were specially produced for this experiment.

OVERVIEW OF LITERATURE

One strand of the literature has focused on comparisons across elicitation mechanisms. For example, the experimental literature on induced value auctions suggests that incentive compatible auctions may not reveal demand consistently across elicitation methods. Lusk and Rousu (2006) suggest that the BDM provides a less accurate reflection of induced values than second price or random *k*th price auctions. Similarly, Noussair et al (2004) report that bids in a second price auction were closer to the induced values than were bids in the BDM arm. Shogren et al (2001), provide evidence suggesting that in second price auctions, bids are closer to induced values when those values are themselves relatively close to market price, but are "misbehaved" especially for low values. On the other hand,

Kagel et al (1987) find that people overbid in second price auctions relative to induced values.

The literature on experiments using commodities, where participants' values are privately known to them, also shows that different incentive compatible mechanisms may yield different estimates of these "homegrown values." For instance, in Rutstrom's (1998) experiment, the mean bid in both BDM and English auctions were significantly lower than that in the second price auction. Various reasons have been adduced to explain such discrepancies, including inadequate training (Plott and Zeiler 2005), experimental environment (Levitt and List 2007), low stakes or high cognitive costs (Lusk et al 2007), and loss aversion (Lange and Ratan 2010; Banerji and Gupta 2014). As explained subsequently, we explicitly tried to address some of these issues in the design, by including training and practice rounds, and reducing the cognitive burden of choices faced by respondents.

Several papers have also compared WTP estimates for commodities using incentive compatible auctions and CEs. In an early paper, Lusk and Schroeder (2006) found that estimated WTP for beef steaks in their CE was more than twice as high as that in a BDM experiment. Gracia et al (2011) also noted significant, though more nuanced, differences, in their elicitation of WTP for cured ham with private and quasi-public good attributes related to animal welfare, using a CE and a random kth price auction. Lusk and Schroeder (2006) emphasized that the CE is similar to making choices in a market with posted, take-it-or-leave-it prices, and participants are therefore more familiar with this system of valuing a product than with auctions. Alphonce and Alfnes (2016) and Elbakidze et al (2014) also found that mean WTP from CE exceeds that from the auctions in their experiments. The latter experiment consisted of a uniform price auction and a CE for the sale of multiple units, and the authors found that the estimated demand curves were less elastic for the CE than for their uniform price auction.

Ginon et al (2014) investigate the issue of consistency of consumer choices by using CE and BDM elicitation in a within-respondent design. They ask whether participants' choices in the CE are consistent with maximizing surplus across products, as calculated by the difference between the BDM bid and the CE posted price for each product. They find that this is the case for about half the participants, while another 30% of the choices can be explained using some suboptimal thumb rule; the remaining 20% of choices cannot be explained. Finally, in an interesting experiment to elicit WTP for genetically modified "golden" rice, Corrigan et al (2009) compare participants' choices in a CE with bids in auctions, with there being five rounds of auctions. They find that mean WTP in the auctions is considerably less than the estimate from the CE in the first round; but by round 5, the auction WTP estimate converges to the CE estimate. This suggests perhaps that increasing familiarity with the auction mechanisms may lead participants' WTP estimates to compare more closely with their choices in a CE. Note however that this was a multiunit experiment, and hence, the CE was open ended, and the auction was a uniform price auction.

Another strand of literature has considered the impact of participation fees on the estimated WTP. Respondents are usually given a participation fee at the beginning of the experiment, sufficient for them to not be out of pocket in making purchases (Smith 1982). Standard theory suggests that since such fees are small relative to the participants' wealth, their effect on WTP should be negligible. However, it has been argued that the

propensity to consume out of such "windfall income" could be different than out of wealth and could bias WTP estimates. The literature on experimental evidence for this is still limited. Some work finds that WTP is affected by variations in participation fee (Loureiro et al 2003; Skuza et al 2015). However, Nalley et al (2005) find that auction bids do not depend on the participation fee if the participants were made to "earn" their fee by doing a task that requires effort. Rutstrom (1998) (while controlling for selection bias) finds that it isn't variations in preannounced participation fees, but rather variations in unanticipated endowments (part of her design) that affect the distribution of auction bids.

There is also now a substantial empirical literature on the WTP for biofortified foods—including for vitamin A maize in other countries—see, for example, De Groote et al (2011) on Kenya, and Meenakshi et al (2012) on Zambia. Other vitamin A crops for which WTP has been estimated include orange sweet potato (see Naico and Lusk 2010 and Stevens and Winter-Nelson 2008 for Mozambique; and Chowdhury et al 2011 for Uganda), orange cassava (see Oparinde et al 2016a for Nigeria), and golden rice (see Corrigan et al 2009 for the Philippines). There is also work on other nutrients such as iron (see Oparinde et al 2016b for beans in Rwanda, and Banerji et al 2016 for pearl millet in India). A synthesis of some of the earlier work is in Birol et al (2015); this paper examines orange maize in rural Ghana that has not been studied before.

EXPERIMENTAL DESIGN

The Products

We compare the WTP across three varieties of maize: orange (biofortified), white, and yellow. Since biofortification results in a substantial change in some characteristics of the staple (in this case the maize is orange in color, owing to its high pro-vitamin A content; this may affect taste also), its acceptance with consumers may be in question. Therefore, we compare its acceptance relative to the traditional white maize. In addition, we also include yellow maize, since both yellow and white maize are familiar to African consumers.[2] Although yellow maize is considered inferior to white maize in many parts of eastern and southern Africa, this is not necessarily the case in western Africa.

Orange maize with high pro-vitamin A content was grown by the Crops Research Institute, Kumasi, while local varieties of white and yellow maize were purchased from the market. Over 80% of our sample reported maize to be a staple food, consumed in various forms. A popular maize product, *kenkey*, was used for the experiments. *Kenkey* is a ready-to-eat food product, and is consumed as a staple food at breakfast, lunch, or dinner. Sold as street food (not generally made at home), it is patronized by people from different socioeconomic backgrounds, and is bought both by the rich and the poor, and by both men and women. In our sample, nearly three-fourths of respondents reported that they made the decision to buy *kenkey* and this proportion did not vary by gender

[2] Although orange and yellow are close on the color spectrum, earlier work suggests that African consumers are able to distinguish orange and yellow varieties. On Zambia, see Meenakshi et al (2012); on Mozambique, see Tschirley and Santos (1995) and Tschirley et al (1996); on Kenya, see de Groote et al (2011); on Zimbabwe, see Rubey and Lupi (1997); on South Africa, see FAO, CIMMYT (1997).

(the "who purchases *kenkey*" question in the instrument allowed for multiple purchasers within a household).

To make *kenkey*, maize is soaked in water for a day or two, then removed from water and milled, and then made into a dough. The dough is left to ferment for a day or two and then prepared into *kenkey* balls; additional details on its preparation are in Amoa-Awua et al (2007) and Haleegoah et al (2016). Furthermore, there are no differences in the preparation of this or other food products because of biofortification; the decision to buy depends only on its taste and buyer preferences. Given that the taste tests were done on *kenkey*, and that it is sold widely, the experiment used regular-sized *kenkey* as the product on which the purchase decisions had to be made, rather than the unprocessed maize.

The Participants and Sampling

The study was conducted in the Ashanti, Central, and Eastern regions of Ghana, which are major maize producers, in November–December 2008. In each region, a set of districts with high consumption of maize and high levels of poverty was shortlisted, as having potential for high impact on public health from the intervention.[3] From this set, one district was randomly selected. Within each district, seven to eight enumeration areas (EAs) were selected (an EA is a village or cluster of small villages as defined by the Ghana Statistical Service; we use the terms EA and village interchangeably). Participants were allocated to treatments that varied by (a) elicitation method, (b) participation fee, and (c) nutrition information. Table 1 summarizes the design of the treatments, while Appendix 1 provides the details of the assignment and randomization.

To avoid possible contamination and confusion through word of mouth, within each district, randomization for the elicitation method and participation fee treatments was done at the level of the EA. As indicated in the top panel of Table 1, three EAs in each district were randomly allocated to the BDM and CE treatment arms each and two EAs to the *k*th price auction.[4] For the BDM and CE elicitations, the three participation fee treatments (40, 80, and 200 pesewas, respectively) were similarly randomly allocated across EAs. The *k*th price auction did not include a participation fee treatment because of budget constraints; all participants were given a uniform 80 pesewas.

The treatments with and without nutrition information were done within each EA (and not across EAs) and participants were randomly assigned to receive the information or not. Additionally, to prevent contamination from the nutrition information, the with nutrition information treatment was conducted in the afternoon.[5]

For each EA, a census of households was obtained from the Ghana Statistical Service. From this listing, we randomly selected 32 households from each EA in which the BDM or CE was used, and 24 households for the *k*th price auctions. The lower panel of Table 1 provides the number of respondents in each treatment arm.

[3] Although the selection of districts should have been based on high consumption of maize combined with high levels of vitamin A deficiency, the latter data were not available at the district level. We therefore used poverty levels as a proxy for the prevalence of vitamin A deficiency.

[4] In Ashanti, it was possible to visit only one of the two EAs assigned to *k*th price auction.

[5] As noted later, to avoid possible time-of-day effects on WTP, we use double difference estimates of impact of nutrition information.

Table 1. Treatment design

A. Enumeration areas by treatment group

Participation fee (pesewas)	Elicitation mechanism		
	BDM	*k*th price auction	Choice experiment
40	3		3
80	3	5	3
200	3		3
Total	9	5	9

B. Number of respondents by treatment group

Participation fee (pesewas)	Elicitation mechanism						
	BDM		*k*th price auction		Choice experiment		
	Without information	With information	Without information	With information	Without information	With information	Total
40	50	47			48	48	193
80	48	47	68	60	48	48	319
200	49	47			46	49	191
Total	147	141	68	60	142	145	703

The elicitation treatments were conducted in a central location in each village, where the field team arrived in the morning with freshly cooked *kenkey* made from the three maize varieties. The *kenkey* takes the color of the maize, so we call these white, yellow, and orange *kenkey*. In each experiment, respondents were given preliminary information about the study, signed a consent form, and received a participation fee. They then responded to a short demographics questionnaire. Next, they tasted the three types of *kenkey* and evaluated each on a five-point scale for appearance, taste, texture, aroma, and overall response. We randomized the order in which the three *kenkey* products were evaluated across participants. Following the sensory evaluations, the elicitation exercise assigned to that village was conducted.

The Treatments

The Elicitation Method Treatments

The BDM Elicitation In this treatment, each participant was asked to bid for white, yellow, and orange *kenkey*, and their bids were recorded. Then one of these three *kenkey* types was randomly selected, with the auction for that type regarded as binding. The participant then drew a slip of paper with a sale price randomly from a box.[6] If his or her bid for the binding *kenkey* type was greater than or equal to this sale price, he or she

[6] This distribution was symmetric around the mean market price of about 20 pesewas for white *kenkey*.

obtained the *kenkey* and paid this price; while if the sale price was higher than the bid, he or she did not get the *kenkey*.

Prior to the actual elicitation of bids, respondents were given detailed instructions on how the auction would proceed and trained on the concept that the optimal choice of bid equaled the maximum that he or she would be willing to pay for the particular type of *kenkey*. Examples were given to show that bidding below or above this maximum could achieve no better payoff for the participant, and could actually turn out worse than bidding their true WTP. Before the actual elicitation, the participant underwent a practice round, which was conducted with a packet of biscuits. The training also emphasized the point that since any of the three products could be selected, all three bids could result in a BDM auction with a "real" consequence (i.e., with an outcome—sale with payment or no sale—that would be implemented).

The *k*th Price Auction Each *k*th price auction was conducted with seven to eight bidders. The top three bidders were awarded *kenkey* as prizes and had to pay a price equal to the fourth highest bid.[7] Thus, the respondents in villages selected for this treatment were divided into groups of seven to eight. For each group of bidders, there were four rounds of auctions.[8] In each round, the eight bidders submitted bids for white, yellow, and orange *kenkey* on slips of paper. At the end of each round, the bids were collected. The top three bidders for each *kenkey* type were declared winners, and their bids (but not their identities), as well as the fourth highest bid, were displayed on a white board. At the end of the four rounds, one round was randomly selected from which one of the *kenkey* types was randomly selected. The three winners from this round paid the fourth highest bid as the price for obtaining the randomly selected *kenkey*.

As with the BDM elicitation, the participants were given detailed instructions and training prior to conducting the auction. This included illustrations on the optimality of bidding one's true WTP, and a practice round with a packet of biscuits. To ensure that participants understood the buying process, each participant had one enumerator to assist him or her, in addition to the enumerator who conducted the auctions and the overall training.

Choice Experiment For the CE, possible price ranges of *kenkey* were discussed with local key informants, and five price points between 10 and 40 pesewas were chosen.[9] For two of the varieties, a full factorial design was used; for the third variety (white—the variety available on the market), the price was fixed at the then prevailing market price of 20 pesewas. We followed this approach so that participants would always evaluate trade-offs with respect to a price that they were familiar with, thus making it easier for them to calculate relative prices. Further, to reduce the complexity of the choices, and to avoid potential fatigue from viewing 25 sets of choices (see Hensher and Prioni 2002; Chowdhury et al 2011), the full set of 25 choice scenarios was randomly divided into five sets, and each respondent was randomly allocated to one of these five sets. To these choice scenarios, a sixth scenario with all three *kenkey* prices equal to 20 was included.

[7] In case of a tie for third place, all the tied participants were awarded the *kenkey* at that price.

[8] Earlier studies (e.g., Lusk et al 2004) suggest bids stabilize by the third or fourth round, justifying our choice of four rounds.

[9] These represented prices around the mean market price of 20 pesewas for white *kenkey*, capturing premiums and discounts relative to this price.

Thus, each participant was given six choice scenarios, each in the form of a choice among the three types of *kenkey* at specified prices. A fourth choice of "none of the above" was always available. Appendix 2 sets out all the choice scenarios utilized in the study, disaggregated by subset.

The three *kenkey* varieties were displayed on plates in front of the respondents as they made their choices (recall that they had previously tasted all three types). In this CE, one of the six scenarios shown was randomly drawn to be the "binding scenario" after the participant made his/her choice for each scenario. For instance, if this scenario had the choices white, orange, and yellow *kenkey* at 20, 25, and 30 pesewas, respectively, and if the respondent had chosen orange *kenkey*, he or she had to buy the orange *kenkey* and pay a price of 25 pesewas.

The Participation Fee Treatments

Three levels of participation fee were offered (40, 80, and 200 pesewas).[10] The lowest was determined as being equivalent to twice the market price of white *kenkey* and therefore sufficient to ensure that even people with substantially higher WTP would not be out of pocket. The largest fee was about 60% of Ghanaian per day per capita gross domestic product in 2008 (World Bank estimates), high enough to detect a possible wealth effect on WTP in the experiment. The participation fee was given at the beginning of the experiment, and considerably before the elicitation took place; participants were told that this fee was a token in return for the time they gave to the experiment. The participation fee for the kth price elicitation was not varied owing to limited budgets; it was fixed at 80 pesewas.

The Information Treatments

Since information campaigns frequently accompany the introduction of a new product (such as orange maize) a treatment was included to assess how much of an impact information would have on WTP (in comparison to a situation where there was no campaign). To this end, the Ghana Broadcasting Corporation was tasked with producing a five-minute simulated radio program in the local language of each region. This was motivated by the fact that radio is a major source of information in rural Ghana. As it turns out, in our survey, radio was mentioned as a major source of agricultural information by three-quarters of respondents, and of information on vitamin A by half. Respondents' knowledge of vitamin A rich foods and the health benefits of consuming vitamin A, however, was low. Only one-third of respondents (who did not receive nutrition information) mentioned various fruits as sources of vitamin A, and one-quarter mentioned green leafy vegetables. Similarly, knowledge of the role vitamin A plays in improving immunity against diseases and maintaining good eyesight was low (33% and 20%, respectively).

The simulated radio program included information on the properties of pro-vitamin A orange maize, as well as the health benefits of vitamin A and vitamin A rich foods for children and adults. An English translation of this message is provided in Appendix 3. Since the orange maize was a proto type, the program was not actually broadcast; instead, respondents in the with nutrition information treatments listened to the program on

[10]One hundred and fifteen pesewas or 1.15 Ghanaian Cedi equaled about 1 U.S. dollar in September 2008.

Table 2. Characteristics of respondents, by treatment group

	Elicitation method treatments			Differences between treatment groups		
	BDM	*k*th price auction	Choice experiment	BDM – *k*th	*k*th – CE	BDM – CE
Age (in years)	42.4 (1.3)	45.8 (2.1)	42.3 (1.3)	–3.4 (2.3)	3.5 (2.4)	0.1 (1.7)
Percentage of females	45.5 (5.0)	49.2 (2.8)	52.9 (3.9)	–3.7 (5.5)	–3.7 (4.4)	–7.4 (5.5)
Asset (Index)	0.0 (0.1)	0.0 (0.1)	0.0 (0.2)	0.0 (0.2)	0.0 (0.2)	0.0 (0.2)
Schooling (in years)	6.0 (0.6)	5.6 (0.7)	5.1 (0.5)	0.4 (0.9)	0.5 (0.9)	0.9 (0.7)
Respondents	288	128	287			

	Participation fee treatments			Differences between treatment groups		
	40 pesewas	80 pesewas	200 pesewas	40 – 80	80 – 200	40 – 200
Age (in years)	42.1 (1.3)	45.2 (1.1)	40.1 (1.6)	–3.1 (1.6)*	5.1 (1.8)**	2.0 (1.9)
Percentage of females	49.7 (6.8)	52.0 (3.1)	44.0 (5.0)	–2.3 (6.4)	8.0 (5.6)	5.7 (7.9)
Asset (Index)	0.2 (0.1)	–0.1 (0.1)	–0.1 (0.2)	0.3 (0.1)**	0.0 (0.2)	0.3 (0.2)
Schooling (in years)	6.0 (0.7)	5.5 (0.5)	5.1 (0.5)	0.5 (0.8)	0.4 (0.7)	0.9 (0.8)
Respondents	193	319	191			

	Information treatments		Difference between treatment groups
	Without information	With information	Without – with
Age (in years)	44.5 (0.9)	41.4 (1.2)	3.1 (1.2)**
Percentage of females	42.6 (3.8)	56.1 (3.5)	–13.5 (4.4)***
Asset (Index)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)
Schooling (in years)	6.0 (0.4)	5.1 (0.3)	0.9 (0.3)***
Respondents	357	346	

Notes: Clustered standard errors are in parentheses. The asset variable is the first principal component of a set of 11 assets relating to household appliances and livestock.
***, ** and * refer to statistical significance at 1%, 5%, and 10%, respectively.

individually provided MP3 players. This also minimized the possibility of contamination across respondents.

DATA AND ESTIMATION STRATEGY

As noted earlier, while the allocation of the mechanism and participation fee treatments was done randomly across villages/EAs within each district, the information treatments were conducted within the village. Respondents in these treatments typically followed those that did not receive any information, so as to limit potential contamination across participants. By and large, this randomization worked.

Table 2 compares treatments across elicitation methods, participation fees, and nutrition information, in terms of the socioeconomic characteristics of participants, as a check on the effectiveness of randomization. There are no differences in any of these

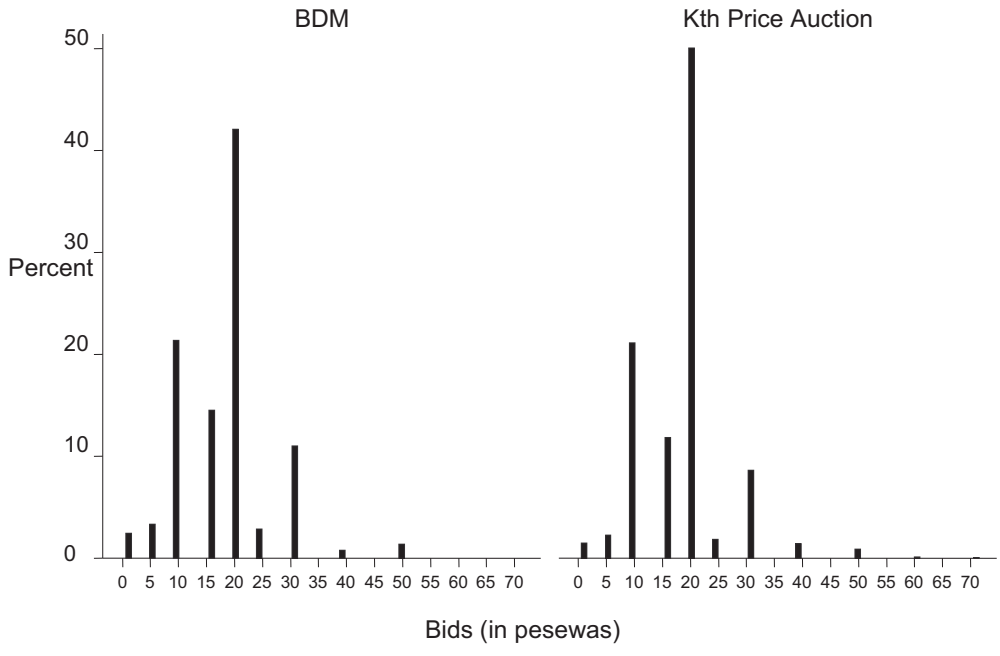

Figure 1. Percentage distribution of bids in BDM and *k*th price auctions

characteristics across the elicitation mechanism treatments. Across participation fee treatments (at levels 40, 80, and 200 pesewas of participation fee) there are some statistically significant, but small differences in age and asset index (computed as the first principal component from a vector of 11 assets). Finally, in a comparison of no information versus with information treatments, the proportion of females in the latter is significantly larger, and there are also small (but significant) differences in age and schooling. The magnitudes of difference are small with the exception of the percentage of females in the nutrition information treatments, and these covariates are controlled for in the regressions described later.

Appendix 4 provides summary statistics on the four attributes of appearance, taste, texture, and aroma that respondents were asked to rank on a scale of 1 to 5, with 5 representing "like very much." All three varieties were generally well liked on all four attributes. In particular, the orange *kenkey* was not ranked lower than the other two varieties.

BDM and *k*th Price Auctions

Figure 1 presents the frequency distributions for the stated WTP in the BDM and *k*th price auctions (aggregated across information and participation fee treatments). Two facts are apparent from the figure. First, a very large fraction of bids (50% in the *k*th price and 42% in the BDM elicitations) are equal to 20 pesewas, the prevailing market price for *kenkey*. This indicates that many bids (irrespective of the variety) were censored at this price, at which people had access to white *kenkey* on the market. In other words, a bid

equal to 20 pesewas could imply that the WTP was at least as large as 20 pesewas, but the bid reflected the price at which it could be purchased in the market.

Second, all the bids are multiples of 5; a result of the fact that the MCU in rural Ghana was five pesewas. This suggests that in addition to the right censoring at 20, WTP was interval censored at each observed level of bid. For example, a person with a WTP of 7, having to bid in units of currency, would bid 5 (bidding 10 would raise the possibility of winning, and paying 10 pesewas in case of a tie, thereby paying an amount higher than the WTP, which is clearly not optimal). Not accounting for the right censoring at 20 and the interval censoring at other bids may bias our WTP estimates downward (in fact this is the case, as discussed in the next section).

The bids are therefore not directly demand revealing; so we first estimate models of WTP as functions of observables, in which we treat the observed bids as right- or interval-censored observations of WTP, and use the average of the predicted values to make comparisons of WTP across treatments (rather than the raw bids themselves). For each of the two auction mechanisms, we model the true WTP[11] as:

$$\ln v_{ij} = x_{ij}'\beta + u_i + \varepsilon_{ij} \tag{1}$$

where $v_{ij}$is the true WTP of participant i for variety j (j equals orange, white, or yellow), x_{ij} is a vector of observables that includes: (a) participant i's age, schooling in years, gender, and an asset index (the first principal component of a vector of 11 assets owned); (b) dummy variables for the variety, for the three regions, for nutrition information if the treatment is with information, and interactions of the region and information with the variety; and (c) a sensory index that was computed as the first principal component of the four attributes of each variety that were elicited from each participant as part of the taste test conducted at the beginning of the survey. The index accounted for much of the variation in the four attributes of texture, taste, appearance, and aroma.[12] Product attributes and quality have a strong bearing on elicited WTP (see, e.g., Melton et al 1996; Demont et al 2013; Lewis et al 2016). For this reason, an attribute-based sensory index is also included in the set of covariates. In addition to these, in the kth price auction, there are constant terms corresponding to the effects of the specific round, while the specification for the BDM auction includes the participation fee as a covariate. Note that u_i is a random effect and ε_{ij} is the error; $u_i + \varepsilon_{ij}$ is normally distributed with mean 0 and standard deviation $\sigma_u + \sigma_\varepsilon$. Thus taking advantage of the panel data yielded by the multiple responses per respondent, the censored model with random effects is estimated using maximum likelihood estimation. Denoting the corresponding cumulative distribution function by F, for an observed bid equal to 20 pesewas (indicating right

[11]We make the parametric assumption that WTP for *kenkey* is lognormally distributed in the population. This is reasonable as it gives nonnegative WTP.

[12]In particular, the sensory index accounted for 70% of the variation in sensory attributes for respondents in the BDM auction, 65% for the kth price auction, and over 90% for the CE. We also ran regressions using each of the individual attributes as regressors, but the more parsimonious formulation was favoured (using the likelihood ratio test) in two of the three elicitation mechanisms, and therefore forms the basis of the analysis. Appendix 7 provides the estimates of WTP using the expanded set of sensory attributes as regressors.

censoring at the market price), the likelihood term (suppressing the variance terms) equals $1 - F(\ln 20 - x_{ij}'\beta)$; and for any other observed bid a, the true WTP is interval-censored on $[a, a + 5)$, so that the likelihood term equals $F(\ln(a + 5)) - F(\ln(a))$.

Choice Experiment

The standard approach for analyzing WTP from CEs is to specify a random utility model:

$$U_{ij} = V_{ij} + e_{ij}; \quad V_{ij} = x_{ij}'\beta \tag{2}$$

where the random utility U that consumer i gets from the *kenkey* variety j depends on a systematic component V_{ij} and a random component e_{ij} (McFadden 1974). We estimate a conditional logit model (CLM); that is, we assume that the random component follows an independent and identically distributed extreme value distribution (see Louviere et al 2000; Train 2009). The covariates that can potentially affect the systematic component are the same as that used in the other two elicitation methods, as detailed in the previous section, with two exceptions: (1) the systematic component is viewed as indirect utility, and therefore the price of alternative j is also a covariate (with an expected negative sign on the associated parameter β_j); and (2) demographic variables, which are constant for an individual, cannot be included as is, because they get eliminated when utility differences across alternatives are specified for the given individual, and are, therefore, interacted with the alternative-specific constants (ASC).

Having estimated the parameters of the CLM, using Hicksian compensation, the expected WTP for *kenkey* type j by consumer i is calculated as the price of *kenkey* that will equate the systematic component V_{ij} to the systematic utility from not purchasing the *kenkey* (usually set to zero). The average WTP of participants in each treatment is then computed as the average of the individual-level WTP. Given this vector of covariates x (including various interaction terms) the WTP for individual i for variety j is given by:[13]

$$WTP_{ij} = -\left(\frac{ASC_j + z_{ij}'\tilde{\beta}}{\beta_{p,j} + \beta_{p\_a,j} \times age_i + \beta_{p\_A,j} \times Asset_i}\right)$$

where ASC refers to the constant specific to variety j; z_{ij} is the vector of covariates excluding the price of j and the interactions of this price with the age and asset index for respondent i, and $\tilde{\beta}$ is the corresponding set of parameters; $\beta_{p,j}$ refers to the coefficient associated with the jth *kenkey* variety's price, $\beta_{p\_a,j}$ is the coefficient associated with the interaction between the jth *kenkey*'s price and age of the ith respondent, while, $\beta_{p\_A,j}$ is that associated with the interaction between the jth *kenkey*'s price and asset index of the ith respondent.

Lexicographic Choices in the Choice Experiment

On examining the CE data, we found that 50% of participants consistently chose *kenkey* made from one specific variety of maize over all others, in all the choice frames, irrespective

[13]So WTP of individual i for good j is the price of j that sets the systematic component of utility to 0. So, it solves the equation: $V_{ij} = ASC_j + z_{ij}'\tilde{\beta} + (\beta_{p,j} + \beta_{p\_a,j} \times age_i + \beta_{p\_A,j} \times Asset_i) \times WTP_{ij} = 0$.

Table 3. Comparing respondents with lexicographic and nonlexicographic preferences in the choice experiments

	Mean (std. error)		
Variable	Nonlexicographic respondents	Lexicographic respondents	Difference
Age (in years)	43.8 (1.5)	40.8 (1.5)	3.0 (1.6)*
Percentage of females	58.0 (7.9)	47.9 (3.6)	10.1 (9.3)
Asset (Index)	–0.1 (0.2)	0.1 (0.2)	–0.1 (0.1)
Schooling (in years)	5.1 (0.6)	5.0 (0.4)	0.1 (0.4)
Respondents	143	144	

Notes: Clustered standard errors in parentheses. The asset variable is the first principal component of a set of 11 assets relating to household appliances and livestock.
*Statistical significance at 10%.

of the changes in relative prices across frames. Such choices have been observed in some earlier CEs (Rosenberger et al 2003). These authors term these choices as arising out of some respondents' "lexicographic preferences." We prefer to call this phenomenon as displaying lexicographic *choices* (since preferences are not observed). The term connotes that participants' choices over (variety, price) pairs are determined *first* by differences in variety, and given the same variety, by differences in price. This latter part of the definition is of course superfluous here: each frame had a single (variety, price) pair for each variety. Thus, a participant who always chooses, say, yellow, prefers all (yellow, yellow price) pairs to (white, white price) and (orange, orange price) choices, irrespective of the levels of the three prices, across all six choice frames offered to the participant.

The lexicographic choices were spread across all three varieties: among these individuals, 47% always chose white *kenkey*, 36% chose yellow, and 17% chose orange *kenkey*. Table 3 shows that there were no differences between lexicographic- and nonlexicographic-choice respondents in terms of their demographic characteristics, with one exception: participants who displayed lexicographic choices tended to be younger by three years, a magnitude unlikely to matter to purchase decisions.

What does a lexicographic choice for a rational individual's preferred variety (orange, yellow, or white *kenkey*) tell us about his or her preferences? Each choice set had at least one frame in which that variety had a highest price of 40 pesewas; we should infer that the individual was willing to pay at least 40 pesewas for this variety. One could therefore have the view that including frames with even higher prices for the preferred variety (keeping fixed the prices of the other varieties) may have led us to observe switches in varietal choices; that is, observing a participant always choosing the same variety could be attributable to an inadequate price range for the varieties. We note, though, that lexicographic choices for a particular variety did not arise out of a dislike for the other varieties. Virtually none of these individuals gave ranks of 3 or lower (on a scale of 1 to 5) to any sensory characteristic of any variety (their average sensory scores were somewhat higher than those given by nonlexicographic-choice individuals—both these being between 4 and 5).

Several observations, however, direct us to an alternative interpretation of the lexicographic choices, relative to the "limited price range" one put forward above. First, the range of prices relative to the market price of white *kenkey* varied from 0.5 to 2 times this price: this should have been adequate enough variation of the price of close substitutes of a staple food, to induce a switch in choice at the very least from buy to not buy. Second, a negligible fraction of participants in the BDM and *k*th price auctions had stated WTP of 40 pesewas and above for any variety (Figure 1), whereas, given our randomized allocation to the three experiments, we should have observed similar proportions of participants with WTP of 40 and above across all of them. Third, even though the CE amounted to making optimal choices across price–variety combinations in six choice frames, the cognitive burden involved in making these choices was significantly higher than in stating WTP in the other elicitation treatments. In the BDM and *k*th price auctions, once the participants had evaluated what their WTP for the different varieties were, they simply had to state those as their bids. On the other hand, in the CE, for each of the six frames, they had to first difference out the prices shown from these WTP, and then choose the variety that yielded the highest (WTP – price) difference (or choose none, if these net differences are all negative); or, even if they did not formally do these calculations, the effort required to make the equivalent, consistent choices across the choice frames was greater. A subset of participants may not have been willing to do so many calculations or put in the required effort.

Instead, a participant who is willing to pay, say, 30 pesewas (or higher) for their preferred variety, and adopts a strategy of choosing that variety in all frames, never loses "on average." The prices of *kenkey* vary across 10, 20, 25, 30, and 40 pesewas. In more than 80% of frames, choosing the preferred variety would be consistent with the WTP of 30 being at least as high as the price displayed for that variety. Furthermore, the average prices of *kenkey* in the five choice sets are approximately 18, 24, 29, 26, and 25 pesewas; all of which are lower than 30. So the structure of the CE may have induced a subset of participants, who valued their preferred variety at 30 pesewas or above, to get by with "satisficing" behavior. Thus, if one of the varieties, say yellow, became salient for a participant at the sensory evaluation phase, he or she could expect to purchase it at an average price of between 18 and 29 pesewas by following a strategy to choose yellow at whatever price it was offered, across all six choice frames (as one of the choice frames was chosen randomly as the binding one); thus getting their preferred variety, making a positive payoff (WTP – price) on average, and avoiding the cognitive burden of calculating alternative payoffs and optimal choices multiple times.

The lexicographic choices of a subset of participants have the following implications for our estimation. Since such participants' choices are not responsive to price changes, it is not possible to estimate the price coefficient in the CLM as it is not identified, implying that the WTP of these individuals cannot be estimated, and by the same argument, nor can their cross price elasticities (see, e.g., Brown et al 2015). We therefore follow a main and a subsidiary course of action. First, we argue that lexicographic choices were made by individuals that are randomly drawn from the population, and display possible satisficing behavior from which it is incorrect to conclude that their WTP for their preferred variety is at least 40 pesewas.[14] Therefore, we estimate this model only for the subset of participants

[14]We do not have data on participants (such as high school scores, math scores, or performance on cognitive tests) that can explain why some individuals faced greater cognitive costs than others.

Table 4. WTP across elicitation mechanisms (without nutrition information) (in pesewas/*kenkey*)

Variety of *kenkey*	BDM	*k*th price auction	Choice experiment – Nonlex
White	23 (0.2)	25 (2.5)	22 (2.0)
Yellow	24 (0.8)	25 (2.2)	28 (1.9)
Orange	22 (0.6)	23 (2.5)	24 (2.2)
Respondents	147	68	72

Notes: These estimates are derived from censored regression models (BDM and *k*th price auctions) and a CLM estimated for the subsample of respondents that did not exhibit lexicographic preferences in the CE. All WTP are evaluated at a participation fee of 80 pesewas. Standard errors in parentheses.

whose choices are not lexicographic. As a subsidiary exercise, we also estimate the model with the full set of participants: in this case, we assign only the ASC as regressors for the lexicographic-choice participants.

RESULTS

WTP Comparisons across Elicitation Methods

Table 4 compares estimated WTP, averaged for each treatment in the absence of nutrition information, but evaluated at a participation fee of 80 pesewas (to ensure comparability of the BDM and CE with the *k*th price auction).[15] WTP for each of the three varieties are similar across elicitation mechanisms, and are certainly within five pesewas of each other, the MCU. For example, the mean WTP for white *kenkey* ranged from 22 to 25 pesewas across the three mechanisms, and that for yellow between 24 and 28 pesewas. With the exception of the BDM and CE comparison for yellow maize, these differences are also statistically insignificant.[16] The similarity of estimates of WTP across elicitation methods extends, by and large, to comparisons at the 25th and 75th quartiles of the estimated WTP distributions, as seen in Appendix 5.

[15]Appendix 8 presents the estimated coefficients for the covariates used in the CE equation (estimated on the subset of nonlexicographic respondents), while Appendix 9 presents the coefficients from the censored models used to estimate WTP in the BDM and *k*th price auctions reported in Table 4. A comparison of coefficients in the BDM, *k*th price and the CLM (for the CE) regressions is, strictly speaking, not valid for reasons outlined in section "Choice Experiment." For example, demographic variables need to be interacted with the variety (color) in the CE in order for them not to be differenced out across choice frames. In addition, the price of each variety in each choice frame is a regressor in the CLM; this is not the case with the *k*th price and BDM specifications. Also, the participation fee does not figure as a covariate in the *k*th price auction regressions. As expected, in all specifications, the coefficients associated with the sensory indices are positive and significant. Also, most of the coefficients associated with gender, age, and schooling are insignificant across elicitation methods, as are the marginal effect of assets on WTP.

[16]Note that the insignificance is not likely a result of inadequate sample sizes, as these were powered to detect differences of five pesewas (one MCU) at an intracluster correlation coefficient of 0.4.

Table 5. Comparison of raw mean bids across auction mechanisms and Choice Experiment using full sample (ignoring lexicographic nature of some responses), without nutrition information (in pesewas/*kenkey*)

Variety of *kenkey*	BDM	*k*th price auction	Choice experiment
White	18 (0.7)	18 (1.9)	37 (10.0)
Yellow	19 (1.2)	18 (1.0)	51 (5.9)
Orange	18 (1.1)	18 (1.0)	22 (20.1)
Respondents	147	68	142

Notes: Standard errors in parentheses. All WTP are evaluated at a participation fee of 80 pesewas.

To what extent is the lack of difference in WTP across elicitation mechanisms attributable to (a) the subsample of nonlexicographic-choice individuals used in our estimates and (b) the censoring used to estimate WTP in the BDM and *k*th price auction elicitations? To address this question, we also estimate the CLM with the entire sample, but following Campbell et al (2007) and Hensher et al (2005), account for lexicographic-choice respondents by specifying that the systematic component of utility for a lexicographic individual is simply specified as an ASC.[17]

A comparison of the predicted WTP for CE generated from (a) the estimation sample restricted to nonlexicographic-choice individuals (reported in Table 4) and (b) using the entire sample (reported in Table 5) suggests that not accounting for the fact that half of our sample consistently chose only one variety, results in estimated WTP that are higher than the corresponding WTP from the estimates restricted to the nonlexicographic subsample for two of the three products (compare column 3 in Tables 4 and 5).[18]

Table 5 also presents the raw means of the bids for the different *kenkey* varieties in the BDM and *k*th price auctions. Across varieties, the mean bids in these two elicitation experiments are statistically no different from each other. However, they are significantly different than the estimated WTP in Table 4, the difference being at least one MCU for white and yellow varieties. Thus, these raw mean bids significantly underestimate the WTP owing to censoring at the market price and over MCU intervals.

For the white and yellow varieties, the mean WTP in Table 5 is approximately twice as high in the CE (estimates that do not account for lexicographic individuals) as compared to the two auction mechanisms. These magnitudes of differences are more comparable to those found in Lusk and Schroeder (2006), thus, accounting for censoring (in auctions) and lexicographic choices (in the CE) matters.

[17]The estimated coefficients from this variant are available from the authors on request.

[18]Appendix 7 presents the estimated WTP using a specification that includes rankings of each of the individual sensory attributes, rather than the sensory index (that is used in Table 4). The inclusion of this specification slightly weakens the conclusions drawn from Table 4. While the inclusion of the sensory index results in no statistically significant difference in WTP across elicitation mechanisms that exceed five pesewas; the specification that includes each of the sensory attributes yields two out of a possible nine comparisons (both involving yellow *kenkey*) for which the difference in WTP across mechanisms is statistically significant and exceeds five pesewas.

Table 6. WTP by participation fees, without information (pesewas/*kenkey*)

	WTP evaluated at a participation fee of 40 pesewas		WTP evaluated at a participation fee of 200 pesewas	
Variety of *kenkey*	BDM	Choice experiment	BDM	Choice experiment
White	22 (0.2)	22 (2.0)	26 (0.2)	21 (2.0)
Yellow	23 (0.7)	28 (1.9)	27 (0.9)	27 (1.9)
Orange	21 (0.6)	24 (2.2)	24 (0.7)	21 (2.2)
Respondents	147	72	147	72

Notes: Standard errors in parentheses. These estimates are derived from censored regression models (BDM and *k*th price auctions) and a CLM estimated for the subsample of respondents that did not exhibit lexicographic preferences in the CE. All WTP are evaluated at a participation fee of 80 pesewas.

Impact of Participation Fee on WTP

Table 6 presents comparisons across participation fees: the effects although statistically significant in some cases are not systematic across elicitation methods, and, more importantly, are indistinguishable within the one MCU. A fivefold increase in participation fee translates into an 18% increase in WTP for white maize in the BDM, and a 5% decrease in the CE, but are once again within one MCU. This also carries over to the other varieties (and to comparisons where the predicted WTP are averaged across with and without information treatments).[19] Taken together, these results are more in line with received theory which suggests that income effects should be small, and stand in contrast to papers that find higher propensities to spend out of windfall income (such as Skuza et al 2015).

Impact of Nutrition Information on WTP

A comparison of WTP across the three varieties in Table 4 suggests that there is a statistically significant discount for orange maize relative to yellow varieties across all three mechanisms, though it is also within one MCU. The WTP for orange and white varieties are close in magnitude, and there is no significant (in terms of the MCU) discount for yellow maize relative to white varieties; if anything, WTP for yellow maize is higher than that for white maize.[20] To see how these WTP rankings change with nutrition

[19]Consistent with the finding that participation fee has no appreciable impact on the WTP for any of the maize varieties (noted in Table 6 and above), two of the three interactions (color times fees) in the CE regression in Appendix 8 are insignificant and while the sign of the third (associated with orange) is contrary to expectations, its magnitude is small. Similarly, the coefficient associated with the participation fee in the BDM regression in Appendix 9 is insignificant.

[20]The near equivalence of white and orange WTP is consistent with evidence from Mozambique, which suggested that even though many participants preferred to trade their orange maize for white maize, there was "little evidence that a substantial price discount would be required over the longer term" for orange maize (Stevens and Winter-Nelson 2008, p. 350). However, the comparisons between white and yellow WTP are different from those in other parts of Sub-Saharan Africa, which report substantial discounts for yellow maize (in part because of its association with food

Table 7. Difference in premium on WTP due to information (double difference) (in pesewas/*kenkey*)

Difference	BDM	*k*th price auction	Choice experiment
Orange – White	3 (0.1)	5 (0.1)	6 (0.1)
Orange – Yellow	4 (0.1)	1 (0.1)	5 (0.1)
Yellow – White	–1 (0.1)	3 (0.4)	1 (0.1)

Notes: Standard errors in parentheses. These estimates are derived from censored regression models (BDM and *k*th price auctions) and a CLM estimated for the subsample of respondents that did not exhibit lexicographic preferences in the CE. All WTP are evaluated at a participation fee of 80 pesewas.

information, Table 7 shows the change in the relative WTP for pairs of varieties in response to the provision of information.

The information provided in the nutrition information treatment was specific to the orange variety and its higher pro-vitamin A content. However, this can, in principle, not only change the perception of the orange variety as being high quality, but also the perception of the existing varieties to be relatively lower in quality in terms of their nutritional and other attributes.[21] Since the three maize varieties are substitutes, preferences may readjust to not only value orange varieties more, but white varieties less. Hence the appropriate measure of the effect of information on WTP is a double difference: interpreted either as (a) the difference between the difference in WTP between, say, orange and white varieties (i.e., the difference in WTP *premia* on color) as a result of information, or equivalently; (b) the difference in WTP for white with and without information, versus the difference in WTP for orange with and without information. The double difference may also help account for any time-of-day effects in the with information treatments: recall that these treatments were conducted in the afternoon to avoid contamination. Other studies (e.g., Demont et al 2012) do find evidence of a time-of-day effect in eliciting preferences.

Using subscripts o and w to denote orange and white maize, $j \in \{b,\ k,\ c\}$ to denote the BDM, kth price and CE mechanisms, and I to refer to with information and O refer to without information, respectively, with x denoting a vector of covariates defined above, then the marginal WTP attributable to information is the double difference (using [b] in the paragraph above):

$$\{[E(WTP_{o,j}|I,\ x) - E(WTP_{o,j}|O,\ x)] - [E(WTP_{w,j}|I,\ x) - E(WTP_{w,j}|O,\ x)]\} \quad (3)$$

These double differences in WTP can analogously be worked out for orange versus yellow and yellow versus white varieties. These estimates suggest that while the provision

aid; see, e.g., Meenakshi et al 2012). There are wide regional differences across countries, and even within Ghana, where yellow maize is traditionally cultivated and consumed. For example, yellow maize is commonly bought in the Eastern and Central districts, but not in Ashanti.

[21]The absolute magnitudes of the WTP after receiving information on the nutritive value of orange maize, presented in Appendix 6, suggest that this may indeed be happening.

of nutrition information increases the difference in WTP for orange relative to white across all mechanisms (all the double difference estimates are significant), it exceeds or equals the MCU for the CE (by six pesewas) and the *k*th price auction (by five pesewas). The relative premium for orange versus yellow *kenkey* is also positive across treatments. Note that there is no premium for yellow relative to white *kenkey*, as might be expected given that both these are familiar products, and were not the focus of the information campaign.[22] Further, although 23% of the respondents in the CE arm lexicographically preferred white *kenkey*, nutrition information reversed this ranking.

These results are in line with studies on other staples, where biofortification leads to a visual change in the product. For example, Meenakshi et al (2012) find that in the absence of information, while orange maize might sell at prices on par with those for white maize in Zambia, an information campaign would translate into a premium for orange maize. Similarly in some regions of Nigeria where biofortified cassava might have sold at a discount relative to white cassava, an information campaign was able to convert this into a premium (Oparinde et al 2016a).

CONCLUSIONS AND DISCUSSION

Our principal results are as follows:

- In a rural Ghanaian setting, with two familiar and one unfamiliar (but substitute) products, there are no economically meaningful differences (defined as being within one MCU) in WTP across elicitation methods, once censoring (for the two auction mechanisms) and lexicographic choices (for the CE) are taken into account. In contrast, the differences in WTP estimated using uncensored regressions for the two auction mechanisms, and the full sample for the CE, are large.
- There is no appreciable impact of the participation fee on the estimated WTP.
- There is no clear evidence of a discount in the WTP for yellow *kenkey*, as compared to white *kenkey*, nor for orange relative to the other two. The provision of nutrition information translates into an increase in the differential between the WTP for orange varieties versus white varieties by one MCU.

What drives these results? Apart from the use of appropriate econometric techniques to estimate WTP (the differences in raw bids and unadjusted WTP for CE are substantial) we believe there are several reasons for this classical flavor of our results, which stand in contrast with much of the literature. First, our participant profile consisted of adults who were experienced in making market purchases of the product (which was a familiar staple) in question. As opposed to this, several earlier experiments that we have cited used students as subjects. As noted in other economic contexts not directly related to this experiment (e.g., in the work of List [2003] and later), it has been seen that more experience can be consistent with standard neoclassical consumer choice behavior, where inexperienced subjects may display behavioral anomalies.

Second, in all cases, detailed instructions were provided to respondents: for example, on why it was optimal to bid their true value in the two auctions, and a practice round

[22]Similarly, difference in coefficients presented in Appendices 8 and 9 associated with information interacted with orange relative to information interacted with white is significant at the 5% level for two of the three elicitation mechanisms.

was also held. As Plott and Zeiler (2005) note in their experiment, adequate training and practice rounds with the incentive compatible elicitation procedure eliminated any differences between WTP and willingness to accept for the object; this suggests a similar relationship between our procedures and optimal bidding. Relatedly, both the BDM and the *k*th price auction likely penalized suboptimal underbidding and overbidding, and led to optimal bidding. Lusk et al (2007) argue that "penalties" for suboptimal bidding vary across mechanisms: for instance, the BDM penalizes both underbidding and overbidding symmetrically, whereas in a second price auction underbidding is penalized less. In our setting in the *k*th price auction, since there were three prizes for eight contestants, it also likely served to penalize both under- and overbidding significantly.

Third, in part because of familiarity with the product, it is unlikely that respondents felt, in response to the participation fee, that they had to "reciprocate" by bidding higher amounts than their true valuations. This is evident from the distribution of bids, where the modal response was, in fact, the market price. It is also likely that the participation fee being offered first, and the elicitation mechanism implemented last, with many tasks (such as tasting the three products) being done in the interim, led to respondents to view this as compensation for their time, rather than as a windfall endowment. Adding more arms to the experiment to distinguish between possible reasons such as these was not feasible; our results nevertheless indicate that participation fees can be included in elicitation experiments without affecting the outcomes significantly.

Fourth, the market price of *kenkey* was approximately one-sixth of the poverty line (of USD 1 per day in 2008), not too low a stake for an experiment. Moreover, participants in poorer countries are often quite sensitive to price changes, so that they would put in effort to make (i) considered decisions in each choice frame of the CE and (ii) think through their choice of how much to bid in the auctions.

It is however the case that only about half of the participants in the CE actually responded to the price–variety trade-offs by switching the chosen variety as the relative prices changed. In thinking about the lexicographic choices made by the rest of the participants, one possibility is that their responses were actually behavioral in nature, in a way that our present experiment is not designed to test. As explained in section "Choice Experiment," a participant who preferred (in the sensory evaluation phase), the taste of a particular variety, could ensure that he or she was able to purchase it for a reasonable expected price, by choosing that variety across all choice frames; in other words, such individuals could "satisfice," getting to a satisfactory outcome, without evaluating price–variety trade-offs optimally. In contrast, in the auction experiments, there was no way to win one's preferred *kenkey* for sure. While the present study is not designed to test satisficing behavior, these lexicographic choices provide the rationale for restricting the estimation subsample in the CE to those who did make these price–variety trade-offs. Doing so provides our WTP comparisons across elicitation methods its classical flavor.

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APPENDICES

Appendix 1. Experiment design profile, by region
Appendix 2. The choice frames
Appendix 3. *Advances in Economic AnalysisAdvances in Economic Analysis* Simulated radio message played to the participants
Appendix 4. Average sensory scores, by elicitation mechanism
Appendix 5. 25th and 75th percentiles of WTP, without nutrition information (pesewas/*kenkey*)
Appendix 6. WTP across elicitation mechanisms, with nutrition information (pesewas/*kenkey*)
Appendix 7. WTP across elicitation mechanisms, without nutrition information (in pesewas/*kenkey*)
Appendix 8. Parameter estimates from the conditional logit model for CE estimated for the subset of non lexicographic individuals
Appendix 9. Parameter estimates from BDM auction and *k*th price auction (censored MLE)