

Cognitive biases and design effects in food auctions: An application to GM rice with health benefits.

Abstract

Experimental auctions are widely used as a value elicitation method to examine consumer preferences for novel, controversial food products. In particular, they have been successfully applied to GM foods and GM crops with health benefits (biofortification) in particular. Despite the increase of interest towards this methodology, and the advantages over hypothetical preference methods, the practice of experimental auctions might lead to a wide variety of cognitive biases and design effects. This paper aims to summarize the key biases in food auction research and to provide scientifically underpinned, methodological procedures in order to control, reduce and assess these biases. Therefore, a checklist of nineteen cognitive biases and design effects was developed. Its applicability and relevance has been successfully shown in a auction study on willingness-to-pay for folate (GM) biofortified rice. The case study findings emphasize the need to consider the risk of various cognitive biases and design effects when developing and organizing experimental auctions, particularly in the field of GM food research.

1. Introduction

Experimental auctions have become increasingly popular as a value-elicitation method because they address the shortcomings of stated and revealed preference methods (Lusk and Shogren, 2007). Due to the non-hypothetical nature of experimental auctions, auction values are typically lower than when applying contingent valuation methods. First, the simulation of an active market with real products and money creates an incentive for participants to state their true value. Second, this valuation method allows the researcher not only to measure the economic value of non-market goods, but also to assess the effect of potential determinants, while controlling the setting. As a consequence, experimental auctions are often applied to elicit consumer valuations for novel, controversial goods, such as genetically modified (GM) crops with improved agronomic traits (Lusk et al., 2005) or enhanced micronutrient content (i.e. GM biofortified crops)(Corrigan et al., 2009), and for controversial technologies in food, like irradiation (Fox et al., 2002) or insecticide use (Roosen et al., 1998).

Despite these advantages, experimental auctions could be subject to various cognitive biases, such as endowment bias, information biases (e.g. serial position effects, confirmation bias) and social behavioral biases (e.g. social desirability bias). Furthermore, specific aspects of the experimental design could lead to misinterpretations, under- or overestimated values, or biased results. Such design effects might be related to organizational aspects (e.g. time-of-the-day effect, panel size effect, product order effects) or the characteristics of the recruitment (e.g. sampling bias), training (e.g. effect of the intensity of training) and the bidding procedures (e.g. method bias, bidder affiliation, auction fever).

This paper aims to give an overview of the key cognitive biases and auction design effects that might occur in food auction research. Thereby, a Chinese auction study on willingness-to-pay (WTP) for GM rice with folate benefits, i.e. folate biofortified rice (FBR), is used as a case study to explore the occurrence of various biases and to provide means to reduce or control them. As FBR has large potential health benefits and is considered a valuable tool to improve folate intake levels in poor, rural populations of China (De Steur et al., 2010a, b), the experimental auctions were conducted in a Chinese folate deficient region that is characterized by challenging socio-economic conditions.

2. Literature Review

2.1. Key Cognitive Biases and Design Effects in Experimental Auctions

Key cognitive biases and design effects are identified through the literature on food auctions and focuses on commonly observed or explored biases in experimental auction research in general and in GM food auctions in particular. As such, the described biases and design effects are highly relevant to the case study, as mentioned in section 3.

The definition and/or description of the potential cognitive biases and design effects is presented in Table 1. For each of them, a broad definition or description is presented, based on (widely cited) peer reviewed publications, reviews, or research contributions that focus on a specific bias. In some of the cases, reference is made to the general economic valuation literature, e.g. contingent valuation studies. Out of the 19 selected effects, five are inherently associated with experimental auctions and/or other economic valuation studies, and bidding procedures in particular. These are: auction fever; bidder affiliation; endowment effect; multiple-good valuation; and reference-dependent valuations. Nevertheless, all biases can be linked to specific experimental auction attributes or procedures, as shown in Table 2.

2.2. Key Findings on the Occurrence of Cognitive Biases and Design Effects in Experimental Auction Research

This section builds further on the selected cognitive biases and design effects in Table 1 and reviews the key empirical results regarding the presence or potential risk of each bias in experimental auction research. The key findings are summarized in Table 2. If possible, reference is made to 2nd price auctions on WTP for (GM) food, as this design is also applied in the case study. Because a few biases are – to our knowledge - linked for the first time to auctions, the description focuses on the expected findings rather than previous results.

Based on the key steps of developing and conducting experimental auctions, the different cognitive biases and design effects could be classified under six categories. Each category reflects different auction characteristics that are prone to bias.

Regarding the *sample characteristics*, the recruitment stage is expected to be subject to sampling biases, either through the timing of the auction, or through the selection procedures to attract participants. Also the number of selected participants, i.e. panel size of the auctions, might affect the results.

Prior to the actual bidding rounds, experimental auctions mostly include *training and practice* to familiarize the participants with the valuation method. Here, a potential training effect and a trail winner effect should be taken into consideration.

When it comes to the design of the actual auctions, specific biases mainly refer to the *number of rounds or goods* (e.g. through diminished marginal utility, the inclusion of multiple products or the presentation order), and, in the case of *information* rounds, the characteristics of the provided information (e.g. the nature of the information and the order of distributing the information).

One of the most important auction characteristics that induce biases, is the methodology behind the valuation method, i.e. *the bidding procedures*. The participant fee that is provided or the presence or absence of price feedback could alter the obtained valuations. Other important choices an auctioneer has to make, are the type of value elicitation method (e.g. English versus Vickrey auctions), the bidding method (full bidding versus endowment), the valuation measure (e.g. WTA versus WTP) and the nature of bidding (oral versus sealed).

The last category of effects refers to the *social environment* which is of particular importance in group based experimental auctions. The competitive nature of bidding with other participants might create auction fever, while the presence of an experimenter could lead to social desirable actions. Another cognitive bias is the false consensus effect, where the need to conform in a social environment results in the false believe that a participant's own (bidding) behavior is normal.

Table 1. Overview of key cognitive biases and design effects: definition and/or description

Cognitive bias/ design effect	Definition and/or description
Anchoring bias	An anchoring bias occurs when people use the randomly proposed bid as a reference point ('anchor') to adjust their initial valuation (Langford and Bateman, 1993). In dichotomous choice contingent valuation methods, for example, the offered price in the starting question often determine the reactions in the second question (Herriges and Shogren, 1996; Ready et al., 1996).
Auction fever (top-dog effect)	Auction fever induces participants to submit high bids for the sake of winning the auction, i.e. to be the 'top dog' (Corrigan and Rousu, 2006a; Lusk and Shogren, 2007). Auction fever is often explained by perceived competition, which is aroused by social facilitation and rivalry (Ku et al., 2005; Malhotra et al., 2008); a quasi- or pseudo-endowment effect, due to increased attachment from perceived ownership (Prelec, 1990); or an attachment effect, which refers to a higher expected probability of winning/buying (Kőszegi and Rabin, 2006). For an overview, see Ehrhart et al. (2008).
Panel size effect	With respect to group-based behavioral experiments, a panel size effect occurs when the number of participants influences the responses. This is particularly important when the panel size has implications for the consequences of behavioral responses.
Bidder affiliation	Bidder affiliation or interdependent bids is a typical auction phenomenon where the presence and knowledge of a high value bidder affects the competitors' bidding behavior (List and Shogren, 1999).
Confirmation bias	A confirmation (Schulz-Hardt et al., 2000; Jonas et al., 2001) or congeniality bias (Hart et al., 2009) is defined as a preference for information that is consistent with preconceptions.
Conflicting product information effects	Although it is generally recognized that positive product information positively influences a consumers' attitude and preference, and vice versa, the effect of providing conflicting information, e.g. both positive and negative statements, is often less conclusive (Fox et al., 2002; Tegene et al., 2003).
Diminished marginal utility	According to the law of diminishing marginal utility, each additional unit of a good that is consumed, lowers the extra utility (Arnold, 2008).
Endowment effect (WTA/WTP)	The endowment effect is often found in experimental research (Brown and Gregory, 1999) and contradicts the standard economic theoretical assumption that willingness-to-accept (WTA) a compensation to give up a good and willingness-to-pay (WTP) to obtain the same good do not differ (Hanemann, 1991). This effect is also known as the ownership effect (Kahneman et al., 1991) or status quo bias (Kahneman et al., 1991). Tversky's loss aversion hypothesis, i.e. a preference to avoid losses, and Kahneman's theory of reference-dependent preferences (see below) are often cited as the reasons for systematic differences between these two valuation methods (Bateman et al., 1997).
False consensus effect	This social cognitive bias occurs when people tend to believe that their own behavior is no different than that from others, i.e. when they have a false belief of consensus (Ross and House, 1977).
Income endowment bias	Endowment effects generally refers to the endowment bidding procedure (see above), but could also be related to the compensatory fee for participants in studies/experiments, especially in the case of experiments with monetary implications. Income endowment bias then refers to the effect of compensatory fees on the participants' responses.
Information order effects (primacy or recency bias)	This serial position effect is a cognitive psychology phenomenon by which the order in which information is presented, influences the results of the study. Thereby, two memory biases are distinguished: primacy versus recency effects. According to these memory biases, a message that is presented first will be more (primacy) or less (recency) remembered than the last presented information (Haugtvedt and Wegener, 1994).
Method bias	In his review, Burton-Jones (2009) defines a method bias as the difference between the measured score of a trait and the trait score that stems from the rater, instrument and/or procedure used to obtain the score (p. 448). In other words, it is the error in a measure that is due to the applied methodology (Cote and Buckley, 1987).
Multiple-good valuation effect	This effect occurs when the valuation for one good is different when other goods (substitutes) are simultaneously presented (Simonson and Tversky, 1992; Lusk et al., 2004).
Product order bias	When evaluating multiple products in consumer research - whether it refers to sensory analysis (Carpenter et al., 2000) or preference studies, the presentation order of the goods might alter the participants' judgment, resulting in a product order bias.
Reference-dependent valuations	This phenomenon states that values in an economic valuation study are dependent on the participant's reference point, i.e. whether he/she possesses the endowed product or not. This is closely related to the 'loss aversion' hypothesis (Tversky and Kahneman, 1991). Because the widely examined reference point effect is the aforementioned endowment effect (Munro and Sugden, 2003), the focus here is on the effect of the

	characteristics of the reference point, i.e. what a participant possesses.
Sampling bias	This type of selection bias results in a biased sample due to the non-randomness of the selected participants (Malhotra and Birks, 2007). The characteristics of the applied method to recruit participants, such as the provided information, the timing and location of recruitment, and the focus of the study largely determines the potential risk of this bias.
Social desirability bias	Social desirability bias (SDB) is a social psychological phenomenon defined as “a tendency of individuals to manage social interactions by projecting favorable images of themselves, thereby maximizing conformity to others and minimizing the danger of receiving negative evaluations from them” (Johnson and Van De Vijver, 2002 , p. 196). Thus, the desire to make a good impression on the others (e.g. interviewer).
Training effect	Extensive training, learning through interaction and practice, is considered extremely important when conducting valuation experiments in order to avoid confusion, misunderstanding, strategic manipulation and, thus, biased results (Brown, 2005; Plott and Zeiler, 2005; Drichoutis et al., 2011).
Trail winner effect	This effect refers to the inclusion of practice rounds in experiments (in line with training). A trail winner effect arises when the response of the winner differs due to his/her awareness of being the winner of the trial sessions.

Table 2. Key findings on the occurrence of cognitive biases and design effects in experimental auction research, per auction characteristic and category

Auction characteristic	Cognitive bias/ design effect	Key findings in experimental auctions
1) Sample characteristics		
Panel size	Panel size effect	Previous research demonstrated that the sample size in auctions is positively associated with higher values (Umberger and Feuz, 2004).
Participant selection	Sampling bias	If only people who are interested in the topic or the method are willing to participate, the sample size will be biased. Especially in laboratory based auctions, where the interest is expected to be lower, a selection bias might be at risk (Lusk and Shogren, 2007).
Time/day	Sampling bias	Conducting experiments during working hours may exhibit a sampling bias, leading to higher rates of unemployed people (Wang and McCluskey, 2010), which affect the results of the experiment. Furthermore, WTP values in food auctions are found to be higher during morning sessions (Hoffman et al., 1993; Rutsaert et al., 2009; De Groote et al., 2010), known as a time-of-the-week effect. Similarly, although evidence is lacking, the selected auction day could also influence and bias the results (a day-of-the-week effect).
2) Training & practice		
Trial auctions	Training effect	A lack of proper training of the participants could lead to underreporting (Drichoutis et al., 2011) and misperceptions about the auction mechanism and its weakly dominant strategy (Brown, 2005). Induced value experiments which applied a 2 nd price auction mechanism, for example, demonstrated the need to include training and practice so that participants understand and learn the basic principles and bidding procedures (Plott and Zeiler, 2005; Harrison, 2006).
	Trail winner effect	In auctions, this effect refers to the awareness of being the winner of the trial auctions. If someone is being informed of winning the trial auction, he/she might behave differently during the actual auctions, due to the expected budget implications or because of the desire to win the auction too (see also auction fever).
3) Number of rounds/goods		
	Diminished marginal utility	This law is at stake when auctioning different products and/or through different auction rounds (Lusk et al., 2004). If a participant would win the first round, she would probably bid lower in the following rounds as the extra utility she will derive from winning the same product would be lower.
	Multiple-good valuation effect	According to List (2002), a preference reversal – or ‘more is less’ phenomenon – occurs when goods are judged together or separately: people tend to change preferences when a good is not considered in isolation and prefer the inferior good. In their

		Vickrey auctions with beef steaks, Lusk et al. (2004) found partial support for a multiple-good valuation effect (and a preference reversal effect) in the full bids, but not in the bid differences.
	Product order bias	The importance of order effects and the need for randomization in value elicitation studies is demonstrated for contingent valuation methods (Clark and Friesen, 2008), conjoint analysis (Chrzan, 1994; De Steur et al., 2012b) but also for experimental auctions (Huffman et al., 2003; Demont et al., 2012). In the latter, order effects refer to the order of the presented auctioned products (information order effects are discussed below).

4) Information provision

	Confirmation bias	In experimental auctions, when an experimenter provides information about the characteristics of an auctioned good, the effect of this information on the bid level is expected to be reinforced by people who already knew this information.
	Conflicting product information effects	These effects are particularly examined in consumer studies on controversial products that are associated with health related behaviors. Previous auction studies have shown inconsistent findings about the direction of the impact of conflicting (dual, opposed, two-sided) information treatments (Fox et al., 2002; Depositario et al., 2009). In general, it is argued that negative information prevails (Fox et al., 2002; Tegene et al., 2003; Parkhurst et al., 2004; Hu et al., 2006), although some researchers disagree (Rousu et al., 2004; Colson and Huffman, 2009; Corrigan et al., 2009). Explanations of the dominance of negative information refer to the alarmist reaction, i.e. conflicting information is treated as negative information (Parkhurst et al., 2004) or even worse (Depositario et al., 2009); a negativity bias (Rozin and Royzman, 2001) ^a , by which negative information is more carefully processed and has a bigger attractiveness (Smith and Petty, 1996); loss aversion or status quo bias (Fox et al., 2002).
	Information order effects	This effect is at stake when the auction design encompasses several information treatments within an auction round, or different information rounds in succession. In the case of a within-subject auction design, where several multiple auction rounds are organized, regardless of the provision of new information in each round, learning or fatigue could lead to order effects (Lusk and Shogren, 2007). In general, the last presented information (recency) is expected to dominate, unless the information is highly relevant to people (Buda and Zhang, 2000). Although such order effects are particularly relevant when providing conflicting information on controversial goods, they are largely neglected in GM food auctions (Liu, 2009).

5) Bidding procedures

Endowment of goods (<i>versus</i> full bidding)	Reference-dependent valuations	Valuations based on an endowment bidding procedure are often criticized for being 'reference-dependent' (see below, endowment effect). While endowing products might decrease valuations through loss aversion, it could also generate a reciprocal obligation effect, by which consumers are bidding higher to reward the auctioneer for their endowment (Corrigan and Rousu, 2006a). In line, although evidence is needed, the characteristics of the selected endowed product might influence valuation differences between the full bidding and endowment approach, as well as to affect valuations for the auctioned product, e.g. due to reciprocity or loss aversion.
Participant fee	Income endowment bias	Compensatory fees are known to alter valuations, particularly in Vickrey auctions (Rutström, 1998). The aforementioned reciprocal obligation might account for this income endowment bias.
Price feedback	Anchoring bias	In auctions, posting a benchmark (field or substitute) price(s) might influence bidding behavior (Harrison et al., 2004; Bernard and He, 2010). Cherry et al. (2004), for example, showed that bids converge towards the price of the outside option. In line, mentioning the price of the endowed product could affect bids. According to Drichoutis et al. (2008) it is likely to have an effect of price posting but there is less evidence on how it affects bid values.
	Bidder affiliation	Price feedback increases the risk of bidder affiliation (Corrigan and Rousu, 2006b), which is likely to occur in auctions with novel, unfamiliar goods, such as GM food (List and Shogren, 1999). Especially low value bidders will be highly affected by high posted prices, reducing their engagement (Lusk and Shogren, 2007), by which all bids converge with the posted winning price (Nunes and Boatwright, 2004). Nonetheless, the problem of affiliated bids and posting prices is mainly associated with the use of repeated rather than information bidding rounds (List and Shogren, 1999).
Sealed <i>versus</i> oral	Bidder affiliation	Price feedback, either through open auction mechanisms, such as in English or Dutch auctions, or by allowing to bid orally in

bidding		order to include illiterate people (Wayua et al., 2009), increases the risk of bidder affiliation.
Valuation measure	Endowment effect (WTA/WTP)	In line with Tversky and Kahneman (1991) a WTA/WTP disparity is expected to occur with higher auction values when applying the WTA measure, i.e. the endowment effect (Shogren et al., 2001a). Based on two meta-analyses, mean WTA/WTP ratios range between 2.5 (Brown and Gregory, 1999) to 2.9 (Horowitz and McConnell, 2002). In other words, participants place a higher value on goods they own relative to goods they do not. According to Lusk et al. (2004), this risk is valid for random n^{th} price auctions, but not for the English and Becker-DeGroot-Maarschalk (BDM) auction mechanisms. When looking at 2 nd price auctions, they even found the opposite, which they called a 'reverse endowment effect'.
Value elicitation method	Method bias	The obtained bids could differ according to the applied auction mechanism (Lusk et al., 2004). Several reasons could be attributed to such value differences: <ul style="list-style-type: none"> - English auction: familiar method, but its open nature increases the risk of bidder affiliation (Harrison et al., 2004); - Vickrey (2nd price): easy to understand/implement (Lusk and Shogren, 2007; Wayua et al., 2009), better for on-margin bidders (Shogren et al., 2001b; Lusk and Rousu, 2006); overbidding more penalized (Lusk and Shogren, 2007); - Random n^{th} price: stimulates competition and appropriate for off-margin bidders (Shogren et al., 2001b; Lusk and Rousu, 2006), but difficulties to understand/implement (Lusk and Shogren, 2007); - Becker-DeGroot-Marschalk (BDM): Appropriate in field settings (Lusk et al., 2001) or developing regions (De Groote et al., 2011), equally penalizes over/underbidding (Lusk and Shogren, 2007), reduces the top-dog effect (Corrigan and Rousu, 2006a), but lacks an active market environment (Shogren et al., 2001a). A value elicitation method bias can also be extended to differences between experimental auctions and other value elicitation methods, such as hypothetical stated preference methods (Balistreri et al., 2001; Völckner, 2005). For example, inferring stated preferences through contingent valuation methods has been shown to lead to higher values, a phenomenon known as hypothetical bias ^b (Johannesson et al., 1998; Balistreri et al., 2001; List and Gallet, 2001; Lusk, 2003; Hanley et al., 2006; Huffman et al., 2007), by which bidding truthfully is not a (weakly) dominant strategy (Werthenbroch and Skiera, 2002). Due to this bias, hypothetical stated bids generally exceed auction values by a factor of 1.35 (Murphy et al., 2005) or 1.65 (Balistreri et al., 2001) to, even, 3 (List and Gallet, 2001).

6) Social environment

	Social desirability bias	Despite evidence of the prevalence of SDB when using self-reporting research methods (Fisher, 1993; King and Bruner, 2000; Johnson and Van De Vijver, 2002; Leggett et al., 2003; Lusk and Norwood, 2006) and hypothetical value elicitation methods in particular (Leggett et al., 2003; Lusk and Norwood, 2009; Olynk et al., 2010), the (non-hypothetical) auctions have rarely been the subject of SDB research. Nevertheless, social desirability could also bias experimental auctions. This could be of major concern in laboratory based auctions, as scrutinizing peoples' bidding behavior in a controlled environment could create a Hawthorne effect (Shogren et al., 1999; Levitt and List, 2005) ^c , especially when the auctioned good may involve negative reactions and the targeted audience is female (Lusk and Norwood, 2006) ^d .
	Auction fever (top-dog effect)	The nature of experimental auctions (market environment, bidding process, self-reported valuations) may not only lead to social desirability bias, but also to auction fever. Some people bid high in order to win the auction (Shogren et al., 2001a; Corrigan and Rousu, 2006a). Although auction fever initially refers to the actual auction rounds, it might also occur in the trial auctions. Especially when these practice rounds have similar monetary implications.
	False consensus effect	In the scope of experimental auctions, this social bias is particularly relevant when using indirect valuation (Lusk and Norwood, 2009).

^a As opposed to optimism bias (Lee and Job, 1995), i.e. a tendency to underestimate risks or negative information.

^b This bias is not incorporated in this study as it applies to stated preference methods.

^c The classic Hawthorne effect states that participants in an experiment are influenced by their participation in the research itself (Levitt and List, 2009).

Closely related to this 'subject expectancy' effect, is the Pygmalion effect or 'experimenter expectancy' effect (Rosenthal and Jacobson, 1992).

^d As these conditions were present in the 'laboratory' based FBR auctions, prudence is in order.

3. Case study: Experimental Auctions for Folate Biofortified Rice

This section applies the aforementioned list of cognitive biases and design effects to a case study. This auction research examines consumers' WTP for folate biofortified rice, i.e. GM rice with health benefits (section 3.1.), by means of 2nd price auctions in a folate deficient region (section 3.2.). In this paper, the focus is on the methodological choices that were taken in order to reduce or measure cognitive biases and design effects (section 3.3.). Furthermore, the occurrence of eleven biases in the obtained bids was tested (section 3.4).

3.1. Folate Biofortified Rice

This case study examines consumers' WTP for rice genetically engineered to contain a higher folate content, known as folate biofortified rice (Storozhenko et al., 2007). Even though this crop is based on a controversial technology, it is considered a cost-effective strategy to reduce folate deficiency, i.e. suboptimal folate intake levels (De Steur et al., 2012a). Folate deficiency is associated with negative health outcomes, such as coronary and cardiovascular diseases, certain types of anemia and cancer (Molloy and Scott, 2001; Blancquaert et al., 2010). Furthermore, a causal link has been established between an inadequate folate status in pregnant women and the risk to deliver a baby with a neural-tube defect, such as spina bifida (Geisel, 2003).

3.2. Experimental Auction Design

In total, 252 women of childbearing age participated in 14 experimental auctions in Shanxi Province, a folate deficient region in Northern China. The rationale behind this target group and research location is based on the high prevalence of both maternal folate deficiency and neural-tube defects (Zhang et al., 2006) and the large potential health benefits of the introduction of FBR in Shanxi Province (De Steur et al., 2010a).

The experimental auctions are built upon a 2nd price (Vickrey) auction mechanism that uses an endowment approach and sealed bidding procedures. Thereby, consumers' WTP for FBR is measured through four non-repeated information rounds, where the following information was provided: (R1) folate content; (R2) folate benefits; (R3) GM technology; (R4) GM information. Building upon Tegene et al. (2003), six different information treatments were equally distributed in the 4th round: positive, negative, objective, dual (positive and negative, or vice versa) and all (positive, negative and objective). The design consists of a briefing, trial auction rounds, rice auction rounds and a debriefing session (for a detailed description of the methodology, see De Steur et al. (2012c).

3.3. Methodological choices to measure, control and reduce key cognitive biases and design effects

In order to measure, (largely) control or reduce various cognitive biases and design effects in the case study, specific measures were taken when developing the auction design or auction procedures were implemented or adapted, as thoroughly described in Table 3.

Table 3. Methodological choices to measure, control and reduce key cognitive biases and design effects in the case study on WTP for FBR

Auction characteristic	Cognitive bias/ design effect	Applied methodology
1) Sample characteristics		
Panel size	Panel size effect	⌊ Because the number of people that participated in the different experimental auctions varied between 9 and 20, a panel size effect might be at stake and is, therefore, tested.
Participant selection	Sampling bias	↑ To reduce sampling bias in the laboratory auctions, we did not mention the specific details of the experiment during the recruitment ^a .
Time/day	Sampling bias	⌊ Sampling biases due to the timing were measured by organizing auctions during weekdays as well as weekends (day-of-the-week effect), and in the morning, afternoon and evening (time-of-the-day effect).
2) Training and practice		
Trial auctions	Training effect	↑ Possible misperceptions were reduced by intensive training and practice (Plott and Zeiler, 2005). The eight steps of Lusk and Shogren (2007, pp. 63-65) were followed: 1) Carefully explain the mechanics of the auction; (2) Provide concrete numerical examples; (3) Clearly explain why it is in each person's best interest to bid truthfully; (4) Use a simple quiz to test individuals' knowledge of the mechanism; (5) Allow questions that pertain to the mechanics of the auction; (6) Conduct several rounds of real-money practice auctions with a non-focal good; (7) Impose anonymity; (8) Once a person has been trained in the auction mechanism, one can run the real money auction for the good of interest.
	Trail winner effect	⌊ If a trial winner is prone to auction fever in the trial auctions, it is expected that similar behavior is exhibited in the actual auctions. Therefore, bids are compared between the bidders who won the trials and those who did not.
3) Number of rounds/goods		
	Diminished marginal utility	↑ To avoid the situation of people bidding less on sequential bidding rounds/products – due to diminished marginal utility or reduced demand - auctions with multiple bidding rounds/products applied a single binding approach (Jaeger and Harker, 2005). Selecting one round as binding is expected to lead to honest bidding behavior in each round (Hobbs et al., 2006), by which people should behave in the same way as when several separate auctions with one single round would have been conducted (Roosen et al., 1998). The same holds for bidding on multiple products. In the FBR auctions, a participant was informed prior to the first round that there is an equal chance to win each round/product, and there is only one winner who has to buy a single product, based on the bids of a selected round.
	Multiple-good valuation effect	⌊ In half of the auctions, a non-GM substitute was auctioned next to FBR. This substitute, i.e. a rice bag with free folic acid pills (FAR), has the same weight, size, color and folate content, which makes it possible to detect significant bid differences between valuations for FBR alone and when FAR is also available.
	Product order bias	↑ When two products were auctioned (see above), the presentation order was randomized. In addition, a three-digit code was randomly assigned to the two products to avoid expectation errors, which is widely applied in sensory and consumer research (Moskowitz et al., 2006), as well as in auction studies (Corrigan and Rousu, 2006a).
4) Information provision		
	Confirmation bias	⌊ Alongside the auction rounds, a survey was administered in order to measure prior knowledge on folate benefits. This allows to explore the presence of confirmation bias.
	Conflicting product information effects	⌊ Out of the six information treatments that are distributed in the 4 th round, the 'dual' and 'all' information sheet makes it possible to test the effect of providing both negative and positive information about the applied GM technology.
	Information order effects (primacy or recency bias)	⌊ Although information treatments/rounds are generally randomized to control for order effects in food auctions, a fixed auction design was deployed with the folate related information rounds being held prior to the GM information rounds. This makes it possible to detect each consumers' value for conventional bred versus GM biofortified rice. In other words, the impact of awareness of the GM technology could be determined. Another reason to avoid

information randomization is to maintain a relatively high sample size to measure other effects. Randomization would have led to a complicated auction design, due to the large number of rounds (5), settings (2) and products (2). Nevertheless, information order effects were measured in round 4, where two dual information treatments were selected to assess potential information order effects: positive-negative versus negative-positive.

5) Bidding procedures

Endowment of goods (<i>versus</i> full bidding)	Reference-dependent valuations	‡	As Lusk et al. (2004) observed, the risk of loss aversion in 2 nd price auctions becomes a major concern after conducting multiple similar rounds and is, thus, less relevant for the non-repeated information rounds in the FBR auctions. To further avoid this risk, a 1 kg rice bag of the 2 nd lowest quality was endowed ^b . As the selection of our endowed product (size, quality) was related to the provided information in the auction rounds (e.g. vitamin content), it was practically less convenient to measure the effect of other endowed rice bags. Neither was it possible to use FBR as the endowed product, as this GM crop is not yet approved for consumption.
Participant fee	Income endowment bias	†	Endowment was applied to mitigate the effect of high monetary participant fees (Rutström, 1998; Loureiro et al., 2003; Cherry et al., 2004). Nevertheless as this might have shifted the reciprocity, this is partially addressed by providing at the start of the auction a small part of the participant fee (¥ 5), which could be used to bid.
Price feedback	Anchoring bias	‡	We posted only the benchmark price of the endowed rice product during the auctions, similarly to other rice auctions in developing countries (Corrigan et al., 2009; Rutsaert et al., 2010). Even though this does not eliminate this bias, all participants had common knowledge of the quality of the auctioned rice product. Regarding the risk of censoring values to market substitutes, this is expected to be of less concern in an endowment bidding approach (Lusk and Shogren, 2007).
	Bidder affiliation	‡	As the FBR design uses non-repeated information rounds, and because the participants are expected to be aware of regular rice prices, price feedback is deemed less useful. In line with Harrison et al. (2004), the bids of the (winning) participants were not revealed during the auction.
Sealed <i>versus</i> oral bidding	Bidder affiliation	†	To avoid this bias, participants are often asked to submit sealed bids. This is typically the case in all n th price auction mechanisms, including 2 nd price auctions. Therefore, the original sealed-bid approach of the Vickrey auction was maintained.
Valuation measure	Endowment effect (WTA/WTP)	‡	Several reasons can be outlined to underpin the appropriateness of choosing WTP over WTA. First, endowing an existing, familiar product and asking if people want to pay more for an improved alternative is in accordance to what consumers are facing in a real market situation. Second, as stated above, the risk of loss aversion is less relevant to the FBR design. Third, the divergence between WTP and WTA leads to substantially higher WTA bids (Lusk et al., 2005; Moon et al., 2007; Dodonova and Khoroshilov, 2009), especially when used in a non-repeated auction design (Shogren et al., 2001a) and when auctioning non-market goods (Horowitz and McConnell, 2002). Another difficulty of using WTA is to define at what value someone becomes opposed, because reluctance in the compensation approach will be reflected by huge monetary values (Jaeger et al., 2004).
Value elicitation method	Method bias	‡	As there is evidence that auction mechanisms – even though they should theoretically generate similar results – lead to different bids, a mechanism should be carefully selected based on the specific auction design and sampling objectives. In the case study, the 2 nd price mechanism was selected for several reasons: <ul style="list-style-type: none"> - Appropriate for low educated participants and local auctioneers (Lusk and Shogren, 2007; Wayua et al., 2009); - Appropriate for on-margin bidders (Shogren et al., 2001b; Lusk and Rousu, 2006), i.e. female rice consumers; - The need to reduce incentives to overbid (Lusk and Shogren, 2007), which might occur as an act of social desirability in the laboratory based FBR auctions; - More accurate than BDM (Noussair et al., 2004).

6) Social environment

Social desirability	‡	In an attempt to reduce SDB on beforehand, the following precautions were taken:
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bias		(1) applying a 2 nd price mechanism to penalize overbidding (as an indicator of SDB) more than underbidding; (2) simplification of the auction procedure by using vulgarized words, extending the amount of training and emphasizing the weakly dominant strategy to obtain true values; (3) making people at ease, e.g. by starting the auction with the easiest part of the auction survey; (4) reducing the bidders' need to please the auctioneer for the incentives, by separating the amount of money to bid (before) and the participant fee (after the auction). In that way, bidders are expected to be less prone to reciprocal obligation (Lusk and Shogren, 2007) as an act of SDB where conformity is triggered by high participant fees; (5) ensuring anonymity by using participant ID codes; (6) measuring SDB through including indirect valuation ^c . There is growing advocacy for an indirect valuation approach, which uses indirect questioning/bidding as a way to depersonalize the personal character of the self-reported bids (Lusk and Norwood, 2009). Therefore, respondents are asked to estimate what others (= typical consumer) think an auctioned good is worth more than the endowed good (Fisher, 1993; Lusk and Norwood, 2006). An indirect valuation stated preference question (iWTP) was included in the survey that accompanied the direct valuation bids of the auction. By doing so, it is possible to compare both direct and indirect valuations, which might reveal potential SDB and validate the direct auction values (explore auction fever, see below).
Auction fever	†	By detaching the personal character of bidding from the valuation exercise, indirect valuation is also used to provide insight in the presence of auction fever in the obtained 'direct' bids (see above). Furthermore, positive outliers (extreme high bidders) could be considered as indications of auction fever. Therefore, we have also explored the high values in the trial and the actual auctions, and the relation between both valuations.
False consensus effect	†	The false consensus effect can be measured by comparing zero bidding behavior in one's direct and indirect valuations.

FAR, rice sold together with folic acid pills; FBR, folate biofortified rice; GM, genetically modified; SDB, social desirability bias; WTA, willingness-to-accept; WTP, willingness-to-pay

Note: The third column refers to the relation between the effects/biases and the case study on WTP for FBR in Shanxi Province.

† effect/bias (largely) controlled; ‡ underpinned approach to reduce the risk of the effect/bias; † effect/bias measured or indications of their potential risk explored.

^a Some authors shifted the auction setting to the field, such as supermarkets (Lusk and Fox, 2003; Lusk et al., 2004). Such an approach could facilitate the recruitment process as the participants self-select into bidding.

^b Endowing a regular rice bag might be associated with an inferior quality signal (Lusk and Shogren, 2007), which is often triggered by applying a left censored valuation approach, i.e. bid to upgrade (>0 to ∞). Future auction research could reduce this bias through a 'split valuation' approach as in Buhr et al. (1993) or Lusk et al. (2001), or to allow negative valuations (Dickinson and Bailey, 2002; Parkhurst et al., 2004; Hobbs et al., 2006; Chern and Chang, 2009).

^c Another option is to include one of many social desirability scales (SDC), which are originally developed for psychological ends. Among the most employed measurements are the Marlowe-Crowne SDC (M-CSDS; 33 items) and its short-item variants (Crowne and Marlowe, 1960; Ray, 1984; Hays et al., 1989; Fleming and Zizzo, 2011); and the Eysinck Lie-Scale (EPQ-L) and its short-item variants (Eysenck et al., 1985; Lajunen and Scherler, 1999).

Below, the methodology to measure or explore the occurrence of eleven biases/effects - as indicated with the symbol 'T' in the 3rd column of Table 3 - is further elaborated. In eight cases a null hypotheses is tested. Except for the conflicting information effects, each null hypothesis corresponds the occurrence of a bias. As the focus is on the measurement of these specific biases, which are not controlled or reduced, it was practically not feasible to examine the effectiveness of procedures to reduce other effects and biases.

Confirmation bias

It is tested whether prior knowledge of the folate benefits, measured after the 1st auction round, affects the bids in the 2nd round, where information regarding these benefits is given.

$$H_0: WTP_R2_{\text{knowledge}} \neq WTP_R2_{\text{noknowledge}} \quad (1)$$

Conflicting product information effects and information order effects

These effects refer to the 4th auction round, when different GM information sheets were distributed. Conflicting product information effects (2) are measured by testing the dominance of negative GM information in the 'dual' and 'all' treatments (see Table 2). Information order effects (3) are tested by comparing the effect of the position of positive GM information in dual treatments.

$$H_0: \text{Negative information prevails in conflicting GM information treatments} \quad (2)$$

$$H_0: WTP_R4_{\text{posneg}} \neq WTP_R4_{\text{negpos}} \quad (3)$$

Multiple-good valuation effect

The null hypothesis assumes a preference reversal, i.e. bid differences between FBR that is considered in isolation or together with non-GM FAR (a rice bag with free folic acid pills):

$$H_0: WTP_{\text{FBRalone}} \neq WTP_{\text{FBR+FAR}} \quad (4)$$

Panel size effects

Potential bid differences according to the number of participants per auction are examined as follows:

$$H_0: \text{Valuations are independent of the panel size.} \quad (5)$$

Time-of-the-day and Day-of-the-week effect

Differences in valuations due to the time (6) and the day (7) of the auctions are tested.

$$H_0: WTP_{\text{morning}} \neq WTP_{\text{afternoon}} \neq WTP_{\text{evening}} \quad (6)$$

$$H_0: WTP_{\text{weekday}} \neq WTP_{\text{weekend}} \quad (7)$$

Social desirability bias, false consensus effect and auction fever

In addition to the ex-ante measures to reduce the occurrence of SDB (see Table 3), indirect stated willingness-to-pay (iWTP) was included as a survey question after the third bidding round, i.e. the last round where participants receive the same amount of information. Participants were asked if they believe that the average female rice consumer in Shanxi would be willing to pay more to exchange her bag of rice with FBR. According to their response, the participants could indicate how much the average Shanxi women is willing to pay more to exchange her product. Instead of switching completely to indirect valuation, the auction design obtains revealed, personalized bids during the bidding rounds and asks for a stated, indirect, depersonalized WTP value in the auction survey.

The occurrence of SDB is then evaluated through the comparison of direct and indirect valuations. Furthermore, also the potential risk of a false consensus effect and auction fever can be explored. While the former could be detected in zero behavior patterns, the occurrence of the latter is mainly found in high personalized bids and outliers of WTP valuations. As these methods are only used to find indications of the potential risk of these social cognitive biases, no null hypotheses are formulated.

Trial winner effect

Based on the results of the trial sessions, it is tested whether being elected as the winner of the trial sessions matters.

$$H_0: WTP_{\text{trialwinner}} \neq WTP_{\text{others}} \quad (8)$$

3.4. Empirical results

This section presents the main findings regarding the selected cognitive biases and design effects that are measured in the case study (see Table 4). Unless otherwise mentioned, these effects are explored through non-parametric tests, such as the Mann-Whitney U test, the Kruskal-Wallis test and the Wilcoxon signed rank test. Below the table, the results are described for each measured bias.

Table 4. Measurement of cognitive biases and design effects in the case study, mean WTP values, per information round, by Mann-Whitney, Kruskal-Wallis and Wilcoxon signed rank tests.

Non-parametric test	Categories	n	Round 1		Round 2		Round 3		Round 4	
			Mean WTP	p	Mean WTP	p	Mean WTP	p	Mean WTP	p
<i>Mann-Whitney U test</i>										
Confirmation bias (1) ^a	no knowledge	194	NA	NA	1.84	0.010 [†]	NA	NA	NA	NA
	knowledge	57	NA	NA	2.50		NA	NA	NA	NA
Multiple-good valuation effect (4)	FBR	125	1.27	0.092	2.07	0.260	1.70	0.456	0.90	0.051 [°]
	FBR+FAR	126	1.56		1.90		1.76		1.27	
Day-of-the-week effect (7)	Weekday	182	1.36	0.800	1.91	0.281	1.69	0.701	1.02	0.726
	Weekendday	69	1.56		2.19		1.82		1.27	
Trial winner effect (8)	No winner	238	1.43	0.933	2.01	0.572	1.74	0.993	1.08	0.323
	Winner	13 ^b	1.11		1.51		1.50		1.13	
<i>Kruskal-Wallis test</i>										
Time-of-the-day effect (6)	Morning	64	1.28		1.93		1.52		1.08	
	Afternoon	109	1.49	0.221	2.04	0.818	1.81	0.171	1.18	0.505
	Evening	78	1.42		1.96		1.80		0.96	
<i>Wilcoxon signed rank test</i>										
Conflicting product information (2) & information order effect (3)	WTP_R4 _{posneg}	42	NA		NA		NA		-0.25 ^c	0.052 [°]
	WTP_R4 _{negpos}	42	NA	NA	NA	NA	NA	NA	-0.67 ^c	0.001 [‡]

NA, not applicable; FAR, rice sold together with folic acid pills; FBR, folate biofortified rice

Note: 1¥ ~ US\$ 0.15. Numbers in the 1st column refer to the hypotheses as formulated in section 3.3.1.

[‡], [†], [°] and indicate significance at 0.1 %, 1 % and 5 %.

^a Knowledge of the benefits of folate, as measured by De Steur et al. (2012c).

^b One of the fourteen trial winners was removed from the analysis due to extreme high bidding (outlier).

^c Δ Mean WTP = $WTP_{R4} - WTP_{R3}$ = GM information effect

Confirmation bias (1)

Knowledge of folate benefits has a reinforcing effect on bidding behavior in round 2, where participants receive information about these benefits in FBR (see also De Steur et al., 2012c). This provides support for a confirmation bias. When the experimenter informed participants about the folate benefits of FBR, this appears to confirm their initial knowledge by which they bid significantly higher.

Conflicting product information effects (2) and Information order effects (3)

Provision of conflicting GM information results in a (significant) downward adjustment of WTP values, which supports the alarmist hypothesis, and thus, the null hypothesis. However, the effect appears to be less pronounced when positive information is presented prior to the negative statements, i.e. a small primacy effect. Regarding the combined treatment, a similar dominance of negative information is observed (see also De Steur et al., unpublished work).

Multiple-good valuation effect (4)

In general, the inclusion of a substitute (FAR) in the experimental auctions did not lead to significant different bids for FBR. Even in the third information round, participant's evaluation of the GM nature of FBR appears not to be affected by the option to buy a non-GM alternative (see also De Steur et al., 2012c). The significant effect in the 4th round disappears when analyzing the different GM treatments separately.

Panel size effect (5)

The size of the auctions did not lead to differences in valuations. Given the limited evidence of a negative effect of increasing the panel size, the panel size is expected to be of less importance than, for instance, the amount of training the participants receive.

Time-of-the-day effect (6) and Day-of-the-week effect (7)

There is no bid difference found according to the time or the day of the auctions.

Social desirability bias, Auction fever and False consensus effect

Comparison of indirect and direct bidding behavior did not support the presence of a social desirability bias. Consumers' estimation of the WTP of the average Shanxi woman is significantly lower than their auction-based valuation of FBR. However, the difference in valuations (¥ 0.65) as well as in zero bidding behavior (-6.1 %) is still relatively low, which makes it hard to support high bidding behavior as an act of SDB or auction fever.

The results only revealed one extreme outlier, which reduces the probability of auction fever. As outliers could influence the mean bids and thus the results, her extremely high bids were excluded from the data analysis. Furthermore, the trial bids and auction bids are not correlated. Except for the 2nd round bids, which are associated with the trial bids in the FBR+FAR rounds ($p < 0.05$). This shows that if there would be any auction fever, it is less likely to occur as a consequent bidding strategy.

Regarding the false consensus effect, a correlation is found between ones' direct and indirect valuation ($p < 0.01$). Even 22.4 % of the total sample did not change the value of their bid. However, when zero bidders are removed, this percentage drops to 6.9 % of the sample. Most of the people (62.2 %) decreased their direct bids, while 15.4 % increased their bids. As for the direction of both valuation methods, a similar tendency is observed. On the one hand, half of the zero bidders (16.7 %) turned their direct zero bid into a positive, indirect bid. On the other hand, 24.3 % of those who valued FBR positively think the average Shanxi woman would not be prepared to pay for this product, and submitted a zero bid. In total, 41 % of the respondents expect that the average Shanxi woman would deviate from her own bids. This reduces the likelihood of a general false consensus effect.

Table 6. Comparison of direct, personalized (iWTP) and indirect, depersonalized (WTP) valuations for FBR, mean values, value differences and significance of the Wilcoxon signed rank test

	Mean ^a		Δ WTP_R3 - iWTP_R3	p
	WTP_R3	iWTP_R3		
n	251	246	NA	NA
Zero bids (%)	17.46	23.58	-6.12	NA
Average bid (in ¥)	1.73	1.08	0.65	0.001
w/o zero bids (in ¥)	2.10	1.41	0.69	0.001

NA, not applicable; WTP, willingness-to-pay; w/o, without

Note: 1 ¥ is about US\$ 0.15. Bold indicates significance at $p < 0.001$.

^a Values are derived from the bidding slip during (WTP) and after (iWTP) the 3rd auction round.

Trail winner effect (8)

There was no significant difference in bidding behavior between those who won the trial auctions and those who did not.

4. Discussion

To the authors' knowledge, this is the first study that addresses the potential risk of cognitive biases and design effects in experimental (food) auctions to this extent. Although this overview of 19 selected effects does not aim to offer an exhaustive overview, it focuses on commonly explored or highly relevant biases in auction research and GM food auctions in particular. In this way, this list of cognitive biases and design effects should be considered as an important checklist when developing and conducting experimental auctions.

By means of an example, this paper also applied this list of biases to a non-market valuation study on FBR as a novel, controversial GM crop with health benefits. In this way, two growing research fields are addressed: consumer research on (GM) biofortification on the one hand, and the use of experimental auctions to elicit valuations for controversial non-market goods on the other. As such, this case study provides a sound and important basis to reduce the impact of key biases in food auction research. While scientifically underpinned procedures to control or reduce several biases are presented, methodological adaptations are proposed in order to measure the occurrence of several biases. Thereby, the data supports the presence of a confirmation bias, conflicting product information effects and an information order effect (e.g. primacy bias). Other biases, such as a multiple-good valuation effect, a panel size effect, a trial winner effect and sampling biases are not observed in the case study. Furthermore, the case study is shown to be less likely affected by social desirability or related social biases, like auction fever.

These case study results emphasize the need to consider the risk of various cognitive biases and design effects when developing the experimental design or to measure them during the auctions. The suggestions to control, reduce and assess key cognitive biases and design effects, can then be considered as the starting point for future auction researchers. As a consequence, there is a need for comprehensive literature reviews and practice oriented research in order to extend and improve the list of biases in experimental auctions and validate our case study results. In addition, a future research area might be to examine the (cultural) applicability of experimental auctions in developing regions and, thus, the checklist. Nevertheless, it is important to note that the relevancy and potential risk of the selected cognitive biases and design effects, as well as the applicability of the methodological procedures will depend on the nature of the auction study.

5. References

- Arnold, R.A., 2008. Economics. Cengage Learning, Hampshire.
- Balistreri, E., McClelland, G., Poe, G., Schulze, W., 2001. Can Hypothetical Questions Reveal True Values? A Laboratory Comparison of Dichotomous Choice and Open-Ended Contingent Values with Auction Values. *Environmental and Resource Economics*, 18, 275-292.
- Bateman, I., Munro, A., Rhodes, B., Starmer, C., Sugden, R., 1997. A Test of the Theory of Reference-Dependent Preferences. *The Quarterly Journal of Economics*, 112(2), 479-505.
- Bernard, J.C., He, N., 2010. Confounded by the Field: Bidding in Food Auctions When Field Prices Are Increasing. *Agricultural and Resource Economics Review*, 39(2), 275-287.
- Blancquaert, D., Storozhenko, S., Loizeau, K., De Steur, H., De Brouwer, V., Viaene, J., Ravanel, S., Rebeille, F., Lambert, W., Van Der Straeten, D., 2010. Folates and folic acid: from fundamental research towards sustainable health. *Critical Reviews in Plant Sciences*, 29(1), 14-35.
- Brown, T.C., 2005. Loss aversion without the endowment effect, and other explanations for the WTA-WTP disparity. *Journal of Economic Behavior & Organization*, 57, 367-379.
- Brown, T.C., Gregory, R., 1999. Why the WTA-WTP disparity matters. *Ecological Economics*, 28, 323-335.

- Buda, R., Zhang, Y., 2000. Consumer product evaluation: The interactive effect of message framing, presentation order, and source credibility. *Journal of Product and Brand Management*, 9(4), 229-242.
- Buhr, B., Hayes, D., Shogren, J., Kliebenstein, J., 1993. Valuing Ambiguity: The Case of Genetically Engineered Growth Enhancers. *Journal of Agricultural and Resource Economics*, 18(2), 175-184.
- Burton-Jones, A., 2009. Minimizing Method Bias through Programmatic Research. *MIS Quarterly*, 33(3), 445-471.
- Carpenter, R.P., Lyon, D.H., Hasdell, T.A., 2000. *Guidelines for Sensory Analysis in Food Product Development and Quality Control*. Aspen Publishers, Gaithersburg, Maryland.
- Chern, W.S., Chang, C.-Y., 2009. Benefit Evaluation of the Country of Origin Labeling in Taiwan: Results from Auction Experiment. American Agricultural Economics Association Annual Meeting, Milwaukee, Wisconsin.
- Cherry, T., Frykblom, P., Shogren, J., List, J., Sullivan, M., 2004. Laboratory Testbeds and Non-Market Valuation: The Case of Bidding Behavior in a Second-Price Auction with an Outside Option. *Environmental and Resource Economics*, 29, 285-294.
- Chrzan, K., 1994. Three Kinds of Order Effects in Choice-Based Conjoint Analysis. *Marketing Letters*, 5(2), 165-172.
- Clark, J., Friesen, L., 2008. The causes of order effects in contingent valuation surveys: An experimental investigation. *Journal of Environmental Economics and Management*, 56(2), 195-206.
- Colson, G., Huffman, W., 2009. Consumers' Willingness to Pay for New Genetically Modified Food Products: Evidence from Experimental Auctions of Intragenic and Transgenic Foods. International Association of Agricultural Economists 2009 Conference, Beijing, China.
- Corrigan, J.R., Depositario, D.P.T., Nayga, R.M., Wu, X., Laude, T.P., 2009. Comparing Open-ended Choice Experiments and Experimental Auctions: An Application to Golden Rice. *American Journal of Agricultural Economics*, 91(3), 837-853.
- Corrigan, J.R., Rousu, M.C., 2006a. The Effect of Initial Endowments in Experimental Auctions. *American Journal of Agricultural Economics*, 88(448-457).
- Corrigan, J.R., Rousu, M.C., 2006b. Posted prices and bid affiliation: Evidence from experimental auctions. *American Journal of Agricultural Economics*, 88(4), 1078-1090.
- Cote, J.A., Buckley, M.R., 1987. Estimating trait, method, and error variance: Generalizing across 70 construct validation studies. *Journal of Marketing Research*, 24(315-318).
- Crowne, D.P., Marlowe, D., 1960. A new scale of social desirability independent of psychopathology. *Journal of Consulting Psychology*, 24, 349-354.
- De Groote, H., Kimenju, S., Morawetz, U., 2011. Estimating consumer willingness to pay for food quality with experimental auctions: the case of yellow versus fortified maize meal in Kenya. *Agricultural Economics*, 42, 1-16.
- De Groote, H., Tomlins, K., Haleegoah, J., Awool, M., Frimpong, B., Banerji, A., Chowdury, S., Meenakshi, J., 2010. Assessing rural consumers' WTP for orange, biofortified maize in Ghana with experimental auctions and a simulated radio message. African Agricultural Economics Association Meeting, Cape Town, South Africa.
- De Steur, H., Gellynck, X., Blancquaert, D., Lambert, W., Van Der Straeten, D., Qaim, M., 2012a. Potential impact and cost-effectiveness of multi-biofortified rice in China. *New Biotechnology*, 29(3), 432-442.
- De Steur, H., Gellynck, X., Blancquaert, D., Storozhenko, S., Liqun, G., Lambert, W., Van Der Straeten, D., Viaene, J., 2012b. Market potential of folate biofortified rice in China, in: Preedy, V.R., Srirajaskanthan, R., Patel, V.B. (Eds.), *Handbook of Food fortification and Health: From Concepts to Public Health Applications* (forthcoming). Springer.
- De Steur, H., Gellynck, X., Feng, S., Rutsaert, P., Verbeke, W., 2012c. Determinants of willingness-to-pay for GM rice with health benefits in a high-risk region: Evidence from experimental auctions for folate biofortified rice in China. *Food Quality and Preference*, 25(2), 87-94.

- De Steur, H., Gellynck, X., Storozhenko, S., Liqun, G., Lambert, W., Van Der Straeten, D., Viaene, J., 2010a. The health benefits of folate biofortified rice in China. *Nature Biotechnology*, 28(6), 554-556.
- De Steur, H., Gellynck, X., Storozhenko, S., Liqun, G., Lambert, W., Van Der Straeten, D., Viaene, J., 2010b. Willingness to Accept and Purchase Genetically Modified Rice with High Folate Content in Shanxi Province, China. *Appetite*, 54, 118-125.
- Demont, M., Zossou, E., Rutsaert, P., Ndour, M., Van Mele, P., Verbeke, W., 2012. Consumer valuation of improved rice parboiling technologies in Benin. *Food Quality and Preference*, 23(1), 63-70.
- Depositario, D.P.T., Nayga, R.M., Wu, X., Laude, T.P., 2009. Effects of Information on Consumers' Willingness to Pay for Golden Rice. *Asian Economic Journal*, 23(4), 457-476.
- Dickinson, D., Bailey, D., 2002. Meat Traceability: Are U.S. Consumers Willing To Pay for It? *Journal of Agricultural and Resource Economics*, 27(2), 348-364.
- Dodonova, A., Khoroshilov, Y., 2009. Behavioral biases in auctions: an experimental study. *Economics Bulletin*, 29(3), 2218-2226.
- Drichoutis, A., Lazaridis, P., Nayga, R.M., 2008. The role of reference prices in experimental auctions. *Economics Letters*, 99(3), 446-448.
- Drichoutis, A., Nayga, R.M., Lazaridis, P., 2011. The role of training in experimental auctions. *American Journal of Agricultural Economics*, 93(2), 521-527.
- Ehrhart, K.-M., Ott, M., Abele, S., 2008. Auction fever: Theory and experimental evidence. SFB 504 Discussion Paper Series No. 08-27 Mannheim University, Mannheim.
- Eysenck, S., Eysenck, H., Barrett, P., 1985. A revised version of the psychoticism scale. *Personality and Individual Differences*, 6(1), 21-29.
- Fisher, R., 1993. Social Desirability Bias and the Validity of Indirect Questioning. *The Journal of Consumer Research*, 20(2), 303-315.
- Fleming, P., Zizzo, D., 2011. Social desirability, approval and public good contribution. *Personality and Individual Differences*, 51(3), 258-262.
- Fox, J.A., Hayes, D.J., Shogren, J.F., 2002. Consumer Preferences for Food Irradiation: How Favorable and Unfavorable Descriptions Affect Preferences for Irradiated Pork in Experimental Auctions. *The Journal of Risk and Uncertainty*, 24(1), 75-95.
- Geisel, J., 2003. Folic acid and neural tube defects in pregnancy - A review. *Journal of Perinatal and Neonatal Nursing*, 17, 268-279.
- Hanemann, W.M., 1991. Willingness to Pay and Willingness to Accept: How Much Can They Differ? *American Economic Review*, 81(3), 635-647.
- Hanley, N., Shogren, J., White, B., 2006. *Introduction to Environmental Economics*. Oxford University Press, Oxford.
- Harrison, G., 2006. Experimental evidence on alternative environmental valuation methods. *Environmental & Resource Economics*, 36, 125-162.
- Harrison, G., Harstad, R., Rutström, E., 2004. Experimental Methods and Elicitation of Values. *Experimental Economics*, 7(2), 123-140.
- Hart, W., Albarracín, D., Ealgy, A.H., Brechan, I., Lindberg, M.J., Merrill, L., 2009. Feeling validated versus being correct: A meta-analysis of selective exposure to information. *Psychological Bulletin*, 135, 555-588.
- Haugtvedt, C.P., Wegener, D.T., 1994. Message Order Effects in Persuasion: An Attitude Strength Perspective. *Journal of Consumer Research*, 21(1), 205-218.
- Hays, R., Hayashi, T., Stewart, A., 1989. A five-item measure of socially desirable response set. *Educational and Psychological Measurement*, 49(629-636).
- Herriges, J.A., Shogren, J.F., 1996. Starting point bias in dichotomous choice valuation with follow-up questioning. *Journal of Environmental Economics and Management*, 30(1), 112-131.
- Hobbs, J., Sanderson, K., Haghiri, M., 2006. Evaluating Willingness-to-Pay for Bison Attributes: An Experimental Auction Approach. *Canadian Journal of Agricultural Economics*, 54, 269-287.

- Hoffman, E., Menkhaus, D., Chakravarti, D., Field, R., Whipple, G., 1993. Using Laboratory Experimental Auctions in Marketing Research: A Case Study of New Packaging for Fresh Beef. *Marketing Science*, 12(3), 318-338.
- Horowitz, J.K., McConnell, K.E., 2002. A Review of WTA / WTP Studies. *Journal of Environmental Economics and Management*, 44, 426-447.
- Hu, W., Zhong, F., Ding, Y., 2006. Actual Media Reports on GM Foods and Chinese Consumers' Willingness to Pay for GM Soybean Oil. *Journal of Agricultural and Resource Economics*, 31(2), 376-390.
- Huffman, W., Rousu, M., Shogren, J., Tegene, A., 2007. The effects of prior beliefs and learning on consumers' acceptance of genetically modified foods. *Journal of Economic Behavior & Organization*, 63, 193-206.
- Huffman, W.E., Shogren, J.F., Rousu, M.C., Tegene, A., 2003. Consumer Willingness to Pay for Genetically Modified Food Labels in a Market with Diverse Information: Evidence from Experimental Auctions. *Journal of Agricultural and Resource Economics*, 28, 481-502.
- Jaeger, S.R., Harker, F.R., 2005. Consumer evaluation of novel kiwifruit: willingness-to-pay. *Journal of the Science of Food and Agriculture*, 85(2519-2526).
- Jaeger, S.R., Lusk, J.L., House, L.O., Valli, C., Moore, M., Morrow, B., Bruce Traill, W., 2004. The use of non-hypothetical experimental markets for measuring the acceptance of genetically modified foods. *Food Quality and Preference*, 15, 701-714.
- Johannesson, M., Liljas, B., Johansson, P.O., 1998. An experimental comparison of dichotomous choice contingent valuation questions and real purchase decisions. *Applied Economics*, 30(5), 643-647.
- Johnson, T., Van De Vijver, F., 2002. Social Desirability in Cross-Cultural Research, in: Harkness, J., Van De Vijver, F., Mohler, P. (Eds.), *Cross-Cultural Survey Methods* John Wiley & Sons, Hoboken, New Jersey.
- Jonas, E., Schulz-Hardt, S., Frey, D., Thelen, N., 2001. Confirmation bias in sequential information search after preliminary decisions: An expansion of dissonance theoretical research on selective exposure to information. *Journal of Personality and Social Psychology*, 80, 557-571.
- Kahneman, D., Knetsch, J.L., Thaler, R.H., 1991. Anomalies: The Endowment Effect, Loss Aversion, and Status Quo Bias. *The Journal of Economic Perspectives (American Economic Association)*, 5(1), 193-206.
- King, M., Bruner, G., 2000. Social Desirability Bias: A Neglected Aspect of Validity Testing. *Psychology & Marketing*, 17(2), 79-103.
- Kőszegi, B., Rabin, M., 2006. A model of reference-dependent preferences. *Quarterly Journal of Economics and Business*, 121(4), 1133-1165.
- Ku, G., Malhotra, D., Murnighan, J.K., 2005. Towards a competitive arousal model of decision-making: A study of auction fever in live and internet auctions. *Organizational Behavior and Human Decision Processes*, 96, 89-103.
- Lajunen, T., Scherler, H., 1999. Is the EPQ Lie Scale bidimensional? Validation study of the structure of the EPQ Lie Scale among Finnish and Turkish university students. *Personality and Individual Differences*, 26, 657-664.
- Langford, I.H., Bateman, I.J., 1993. Welfare measures for contingent valuation studies: estimation and reliability. *Global Environmental Change Working Paper 93-04*. University College London, Centre for Social and Economic Research on the Global Environment.
- Lee, S.H.V., Job, R.F.S., 1995. The effect of information on optimism bias, in: Kenny, D.T., Job, R.F.S. (Eds.), *Australia's adolescents: A health psychology perspective*. University of New England Press, Armidale, Australia.
- Leggett, C., Kleckner, N., Boyle, K., Duffield, J., Mitchell, R., 2003. Social Desirability Bias in Contingent Valuation Surveys Administered through In-Person Interviews. *Land Economics*, 79(4), 561-575.
- Levitt, S.D., List, J.A., 2005. What Do Laboratory Experiments Tell Us About the Real World? Working Paper. Department of Economics, University of Chicago, Chicago.

- Levitt, S.D., List, J.A., 2009. Was there really a Hawthorne effect at the Hawthorne Plant? An analysis of the original illumination experiments. NBER Working Paper No. 15016. National Bureau of Economic Research Cambridge.
- List, J.A., 2002. Preference Reversals of a Different Kind: The 'More is Less' Phenomenon. *American Economic Review*, 92, 1636-1643.
- List, J.A., Gallet, C.A., 2001. What Experimental Protocol Influence Disparities Between Actual and Hypothetical Stated Values? Evidence from a Meta-Analysis. *Environmental and Resource Economics*, 20, 241-254.
- List, J.A., Shogren, J.F., 1999. Price information and bidding behavior in repeated second-price auctions. *American Journal of Agricultural Economics*, 81(4), 942-949.
- Liu, P., 2009. Consumers' WTA for GM rice cookie: an experiment study in China. International Association of Agricultural Economists Conference, Beijing, China.
- Loureiro, M., Umberger, W.J., Hine, S., 2003. Testing the Initial Endowment Effect in Experimental Auctions. *Applied Economics Letters*, 10, 271-275.
- Lusk, J.L., 2003. Effects of Cheap Talk on Consumer Willingness-To-Pay for Golden Rice. *American Journal of Agricultural Economics*, 85(4), 840-856.
- Lusk, J.L., Feldkamp, T., Schroeder, T.C., 2004. Experimental Auction Procedure: Impact on Valuation of Quality Differentiated Goods. *American Journal of Agricultural Economics*, 389-405.
- Lusk, J.L., Fox, J.A., 2003. Value Elicitation in Retail and Laboratory Environments. *Economics Letters*, 79, 27-34.
- Lusk, J.L., Fox, J.A., Schroeder, T.C., Mintert, J., Koohmaraie, M., 2001. In-Store Valuation of Steak Tenderness. *American Journal of Agricultural Economics*, 83, 539-550.
- Lusk, J.L., Jamal, M., Kurlander, L., Roucan, M., Taulman, L., 2005. A meta-analysis of genetically modified food valuation studies. *Journal of Agricultural and Resource Economics*, 30(1), 28-44.
- Lusk, J.L., Norwood, F.B., 2006. Social Desirability Bias in Willingness-to-Pay for Products with Normative Attributes. American Agricultural Economics Association Annual Meeting, Long Beach, California.
- Lusk, J.L., Norwood, F.B., 2009. Direct Versus Indirect Questioning: An Application to the Well-Being of Farm Animals. *Social Indicators Research*, 96(3), 551-565.
- Lusk, J.L., Rousu, M.C., 2006. Market Price Endogeneity and Accuracy of Value Elicitation Mechanisms, in: List, J. (Ed.), *Using Experimental Methods in Environmental and Resource Economics*. Edward Elgar Publishing, Hants, England.
- Lusk, J.L., Shogren, J.F., 2007. *Experimental auctions: Methods and applications in economic and marketing research*. Cambridge University Press, Cambridge.
- Malhotra, D., Ku, G., Murnighan, J.K., 2008. When winning is everything. *Harvard Business Review*, 86(5), 78-86.
- Malhotra, N.K., Birks, D.F., 2007. *Marketing Research: An Applied Approach*. Prentice Hall, London.
- Molloy, A., Scott, J., 2001. Folate and prevention of disease. *Public Health Nutrition*, 4(2B), 601-609.
- Moon, W., Balasubramanian, S.K., Rimal, A., 2007. Willingness to Pay (WTP) a Premium for Non-GM Foods versus Willingness to Accept (WTA) a Discount for GM foods. *Journal of Agricultural and Resource Economics*, 32(2), 363-382.
- Moskowitz, H.R., Beckley, J.H., Resurreccion, A.V.A., 2006. *Sensory and Consumer Research in Food Product Design and Development*. Wiley-Blackwell/IFT Press, Ames, IA.
- Munro, A., Sugden, R., 2003. On the theory of reference-dependent preferences. *Journal of Economic Behavior & Organization*, 50(4), 407-428.
- Murphy, J., Allen, P., Stevens, T., Weatherhead, D., 2005. A meta-analysis of hypothetical bias in stated preference valuation. *Environmental and Resource Economics*, 30(3), 313-325.

- Noussair, C., Ruffieux, B., Robin, S., 2004. Revealing consumers' willingness to pay: A comparison of the BDM mechanism and the Vickrey auction. *Journal of Economic Psychology*, 25(6), 725-741.
- Nunes, J.C., Boatwright, P., 2004. Incidental prices and their effect on willingness to pay. *Journal of Marketing Research*, 41(4), 457-466.
- Olynk, N., Tonsor, G., Wolf, C., 2010. Consumer Willingness to Pay for Livestock Credence Attribute Claim Verification. *Journal of Agricultural and Resource Economics*, 35(2), 261-280.
- Parkhurst, G., Shogren, J., Dickinson, D., 2004. Negative Values in Vickrey Auctions. *Journal of Agricultural Economics*, 86(1), 222-235.
- Plott, C.R., Zeiler, K., 2005. The Willingness to Pay - Willingness to Accept Gap, The 'Endowment Effect', Subject Misconceptions and Experimental Procedures for Eliciting Valuations. *American Economic Review*, 95, 530-545.
- Prelec, D., 1990. A "pseudo-endowment" effect and its implications for some recent non-expected utility models. *Journal of Risk and Uncertainty*, 3, 247-259.
- Ray, J., 1984. The reliability of short social desirability scales. *The Journal of Social Psychology*, 123, 133-134.
- Ready, R.C., Buzby, J.C., Hu, D., 1996. Differences between continuous and discrete contingent value estimates. *Land Economics*, 72, 397-411.
- Roosen, J., Fox, J.A., Hennessy, D., Schreiber, A., 1998. Consumers' Valuation of Insecticide Use Restrictions: An Application to Apples. *Journal of Agricultural and Resource Economics*, 23(2), 367-384.
- Rosenthal, R., Jacobson, L., 1992. *Pygmalion in the classroom* Irvington, New York.
- Ross, L.G., D, House, P., 1977. The false consensus phenomenon: An attributional bias in self-perception and social perception processes. *Journal of Experimental Social Psychology*, 13(3), 279-301.
- Rousu, M.C., Huffman, W.E., Shogren, J.F., Tegene, A., 2004. Estimating the Public Value of Conflicting Information: The Case of Genetically Modified Foods. *Land Economics*, 80(1), 125-135.
- Rozin, P., Royzman, E.B., 2001. Negativity Bias, Negativity Dominance, and Contagion. *Personality and Social Psychology Review*, 5, 296-320.
- Rutsaert, P., Demont, M., Ndour, M., Tollens, E., 2009. Competitive Rivals: Willingness-to-pay for Senegal River Valley versus Imported Rice. CREDA (the Centre for Research on Agro-food and Development Economics) workshop, Barcelona.
- Rutsaert, P., Demont, M., Ndour, M., Verbeke, W., Seck, P., Tollens, E., 2010. Paying for Quality: Private versus Collective Valuation of Senegal River Valley Rice. Africa Rice Congress 2010, Bamako, Mali.
- Rutström, E., 1998. Home-grown values and incentive compatible auction design. *International Journal of Game Theory*, 27, 427-441.
- Schulz-Hardt, S., Frey, D., Luthgens, C., Moscovici, S., 2000. Biased information search in group decision making. *Journal of Personality and Social Psychology*, 78, 655-669.
- Shogren, J.F., Cho, S., Koo, C., List, J.A., Park, C., Polo, P., Wilhelmi, R., 2001a. Auction mechanisms and the measurement of WTP and WTA. *Resource and Energy Economics*, 23, 97-100.
- Shogren, J.F., Fox, J.A., Hayes, D.J., Roosen, J., 1999. Observed Choices for Food Safety in Retail, Survey and Auction Markets. *American Journal of Agricultural Economics*, 81(5), 1192-1199.
- Shogren, J.F., Margolis, M., Koo, C., List, J.A., 2001b. A random nth price auction. *Journal of Economic Behavior & Organization*, 46, 409-421.
- Simonson, I., Tversky, A., 1992. Choice in Context: Tradeoff Contrast and Extremeness Aversion. *Journal of Marketing Research*, 29, 281-295.
- Smith, S.M., Petty, R.E., 1996. Message framing and persuasion: a message process analysis. *Personality and Social Psychology Bulletin*, 22(3), 257-268.

- Storozhenko, S., De Brouwer, V., Volckaert, M., Navarrete, O., Blancquaert, D., Zhang, G.-F., Lambert, W., Van Der Straeten, D., 2007. Folate fortification of rice by metabolic engineering. *Nature Biotechnology*, 25(11), 1277-1279.
- Tegene, A., Huffman, W.E., Rousu, M.C., Shogren, J.F., 2003. The Effects of Information on Consumer Demand for Biotech Foods: Evidence from Experimental Auctions. ERS/USDA Research Briefs Technical Bulletin No 1903. United States Department of Agriculture, Washington, DC.
- Tversky, A., Kahneman, D., 1991. Loss aversion in riskless choice: A reference-dependent model. *Quarterly Journal of Economics*, 106(4), 1039-1061.
- Umberger, W.J., Feuz, D.M., 2004. The Usefulness of Experimental Auctions in Determining Consumers' Willingness to Pay for Quality Differentiated Products. *Review of Agricultural Economics*, 26(2), 170-185.
- Völckner, F., 2005. Biases in Measuring Consumers' Willingness to Pay. Research Paper on Marketing and Retailing. No. 25. University of Hamburg, Hamburg.
- Wang, H., McCluskey, J., 2010. Effects of Information and Country of Origin on Chinese Consumer Preferences for Wine: An Experimental Approach in the Field Agricultural & Applied Economics Association 2010 AAEA, CAES, & WAEA Joint Annual Meeting, Denver, Colorado.
- Wayua, F., Shibia, M., Mamo, M., Bailey, D., Coppocke, D., 2009. Willingness to Pay for Improved Milk Sensory Characteristics and Assurances in Northern Kenya Using Experimental Auctions. *International Food and Agribusiness Management Review*, 12(3), 69-88.
- Wertenbroch, K., Skiera, B., 2002. Measuring Consumers' Willingness to Pay at the Point of Purchase. *Journal of Marketing Research*, 39, 228-241.
- Zhang, L., Ren, A., Li, Z., Hao, L., Tian, Y., Li, Z., 2006. Folate concentrations and folic acid supplementation among women in their first trimester of pregnancy in a rural area with a high prevalence of neural tube defects in Shanxi, China. *Birth Defects Research Part A: Clinical and Molecular Teratology*, 76, 461-466.