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Examining survey participation and response quality: The significance of topic salience and incentives

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Abstract

Nonresponse bias has been a long-standing issue in survey research (Brehm 1993; Dillman, Eltinge, Groves and Little 2002), with numerous studies seeking to identify factors that affect both item and unit response. To contribute to the broader goal of minimizing survey nonresponse, this study considers several factors that can impact survey nonresponse, using a 2007 Animal Welfare Survey Conducted in Ohio, USA. In particular, the paper examines the extent to which topic salience and incentives affect survey participation and item nonresponse, drawing on the leverage-saliency theory (Groves, Singer and Corning 2000). We find that participation in a survey is affected by its subject context (as this exerts either positive or negative leverage on sampled units) and prepaid incentives, which is consistent with the leverage-saliency theory. Our expectations are also confirmed by the finding that item nonresponse, our proxy for response quality, does vary by proximity to agriculture and the environment (residential location, knowledge about how food is grown, and views about the importance of animal welfare). However, the data suggests that item nonresponse does not vary according to whether or not a respondent received incentives.

Key Words: Survey nonresponse; Survey participation; Leverage-salience; Prepaid incentives; Item nonresponse; Missing data.

1. Introduction

Nonresponse bias has been a long-standing issue in survey research, as it affects all survey research regardless of mode (Nathan 2001). As a result, numerous studies have sought to identify factors that affect both item and unit response/nonresponse in various survey modes (Grove 2006; Trussell and Lavrakas 2004; Davern, Rockwood, Sherrod and Campbell 2003; Teitler, Reichman and Sprachman 2003; Singer, Van Hoewyk and Maher 2000; Singer, Van Hoewyk, Maher 1998; James and Bolstein 1992). While these studies have generated insightful and useful information about the factors that affect survey participation, questions about survey response still remain pertinent to the field of survey research in general and to our substantive work in particular. We are interested in expanding on the thoughts of Groves *et al.* (2000) by investigating whether specific characteristics of sampled units or demographic subpopulations in relation to a survey's topical context affect the response patterns. In our ongoing research assessing the general public's attitudes and behaviours related to the agricultural and environmental domain, we have become increasingly concerned about the level of survey participation and item nonresponse in distinct subpopulations. In our case, one concern is that unit and item nonresponse may vary among individuals or households that are more or less physically or socially proximate to the agricultural landscape, which is the focal area of our public opinion surveys.

To contribute to the broader goal of minimizing item and unit nonresponse and address some of our concerns, we reconsider several factors that can impact survey participation and item nonresponse. Specifically, we examine the effects of a survey's subject context (that is, its main focus) on survey participation and item nonresponse. We anticipate that participation in a survey will be systematically affected by how salient the survey's topic is to each sampled unit This expectation draws on the leverage-saliency theory (Groves *et al.* 2000), which anticipates that a variety of factors related to a survey's main features or features made prominent during survey administration might impact participation. Our research will also reconsider the effects of prepaid incentives on survey response. Given that offering incentives to sampled units has remained an enduring and widespread practice in the survey industry, we think it behoves survey researchers to periodically reassess the relationship between incentives and survey participation, using varying contexts. Such a continuous assessment of the utility of incorporating incentives into surveys is important because we cannot assume that incentives will always work as intended.

In the next section, we briefly describe the problem of survey nonresponse and then review research on how increasing the salience of some survey features and offering prepaid incentives affect participation and item non-response. The final two sections will cover the research design and results of the study.

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2. Survey nonresponse and potential consequences

Survey nonresponse describes the situation in which a sampled unit fails either to participate in the survey altogether (unit nonresponse) or to respond to one or more survey items (item nonresponse). Survey nonresponse has been a long-standing issue in survey research. Singer (2006) observes that "analysis of JSTOR statistical journals dates the first nonresponse article from 1945 and the *Public Opinion Quarterly* index's earliest reference is from 1948" (page 637). However, well-established and nascent survey projects alike are experiencing steadily declining response rates despite this awareness. For example, the University of Michigan's Survey of Consumer Attitudes (SCA) has witnessed a drop in response rate from about 72 percent in 1979 to about 60 percent in 1996 and a low of 48 percent in 2003 (Curtin, Presser and Singer 2005).

Survey nonresponse at both the unit and item levels obviously represents a major challenge to survey research, given its potential for generating nonsampling errors in parameter estimates (Brehm 1993; Dillman *et al.* 2002; Groves and Cooper 1998). For example, nonresponse may lead to biased point estimators, variance inflation for point estimators, and biases in estimators of precision (Dillman *et al.* 2002; Groves and Cooper 1998). Although unit and item nonresponse mean different things conceptually in the survey literature, their effects on a statistical estimate are generally the same (Groves, Fowler, Jr., Couper, Lepkowski, Singer and Tourangeau 2004).

While a number of recent studies suggest that low (unit) response rates may not have serious adverse effects on data quality (Curtin, Presser and Singer 2000; Keeter, Miller, Kohut, Groves and Presser 2000; Visser, Krosnick, Marquette and Curtin 1996), the fact still remains that unit nonresponse can have negative consequences for statistical estimates under certain circumstances. As a result, finding creative ways to increase response rates so that all types of sampled units are represented adequately in the sample remains a key goal in survey research. For item nonresponse, it may be true that advances in post-survey techniques for handling missing data, such as hot-deck and cold-deck imputations, mean imputation, multiple imputation, and multiple imputation and deletion, have made it possible to reduce the challenges this poses. However, the ideal situation and, in fact, a primary goal of survey design and implementation is to minimize item nonresponse to the greatest extent possible. This is because the norm in some fields, especially in microeconomics, is to use only the original data (Cameron and Trivedi 2009).

3. Making salient key features of a survey and survey participation

The extent to which a sampled unit views some features of a survey as more or less important affects the respondent's likelihood of participating in the survey (Groves *et al.* 2000). Groves *et al.* (2000) comment on the interviewing tactics of experienced interviewers, arguing that what interviewers actually do when they tailor their queries or remarks to the concerns of respondents is "to heighten the salience of some features of the request, those they judge will be favorably received by the household" (page 299). Building on Groves and Cooper (1998), Groves *et al.* (2000) propose what they call the *leverage-saliency theory* to explain how sampled units make the decision to participate or decline to participate in a survey. This theory essentially states that there are some attributes (leverage) of a survey that may be viewed negatively or positively by the respondent, and that how these attributes are made salient during the survey request process affects the likelihood of participation. If attributes viewed positively by a sampled unit (positive leverage) are made salient during the survey request, there is a higher chance that the respondent agrees to participate in the survey, all other things being equal. On the other hand, the likelihood of a sampled unit participating in a survey will be hurt if attributes that are viewed negatively by the respondent are made salient during the survey request.

Groves *et al.* (2000) empirically support this theoretical position. They present civic engagement (measured by community involvement) and incentives as leverages on survey participation, successfully showing that both attributes positively affect the likelihood of participation, with the effect of incentives diminishing among sampled units with higher civic engagement. In using civic engagement as a measure of a survey's leverage on sampled units, Groves *et al.* (2000) observe that leverage is not measured directly. Instead, it may be gleaned from some characteristic(s) of respondents in relation to the survey or its features, which may exert a positive or negative influence on the likelihood of participation. There is also evidence that when survey requests are tailored to the concerns of sampled units or to what they consider to be important, the likelihood of their participation is enhanced (Dillman 2000; Groves and Cooper 1998).

Based on the leverage-saliency theoretical proposition, we expect higher rates of participation from respondents whose characteristics make them more likely to view important attributes (leverage) of a survey positively. Correspondingly, we also expect those whose characteristics make them less likely to view such attributes positively to participate in the survey at lower rates. In our particular area

of research, we anticipate that sampled units' proximity to the agricultural and rural landscape (the contextual focus of our on-going survey) will affect participation in the survey and item nonresponse. This logic also applies to our expectations about respondents who claim greater knowledge of how food is produced and who also view animal welfare as important (a central sub-theme of this particular work). We thus draw from the leverage-salience theoretical proposition to propose the following hypotheses.

1. Our survey's focus on agriculture and the environment, which was made salient in its design, is expected to exert a positive leverage on respondents with greater social and physical proximity to agriculture and the rural environment (that is, those residing in more rural places). We thus hypothesize that participation rates will vary according to residential location.
2. We expect respondents with a closer proximity to agriculture and the rural landscape to be more diligent in completing the survey than those not in close proximity, as the former are more likely to be motivated by the survey's subject matter (that is, its positive leverage). We thus hypothesize that item nonresponse will vary by proximity to agriculture and the rural landscape.
3. Sampled units who have greater knowledge of how their food is grown as well as those who view animal welfare as important will have fewer item nonresponses. Presumably, such respondents will have a greater interest in the survey's focus on agriculture and the environment, and therefore exhibit more diligence in completing the survey.

4. Incentives and survey participation

The use of various forms of incentives, particularly prepaid (monetary) incentives, has become a common practice in survey research. While the practical rationale for offering incentives to sampled units is to encourage participation, the theoretical root of this practice is in part traceable to the *social exchange theory* (Dillman 1978). The social exchange theory assumes that people's actions are primarily motivated by the returns they expect or obtain from engaging in an activity (Weisberg 2005). Gouldner (1960) elaborates on the norm of reciprocity, which is related to the social exchange theory, observing that "insofar as men live under such a rule of reciprocity, when one party benefits another, an obligation is generated. The recipient is now *indebted* to the donor, and he remains so until he repays" (page 174). In Gouldner's view, the norm of reciprocity makes two demands on people: (1) people should help those who have helped them, and (2) people should not injure those who have helped them (Gouldner 1960, page 171).

Dillman (1978) uses the social exchange theory and particularly the social norm of reciprocity to argue that relatively small gestures (such as personalized letters, incentives, and reminder letters) can evoke reciprocation from sampled households in terms of inclination to participate in a survey. Also, Weisberg (2005) notes that social exchange is a theory that possibly explains the relationship between incentives and survey participation, observing that "[f]rom this perspective, giving the respondent a monetary incentive to participate in the survey can be seen as a kindness that evokes a norm of reciprocity" (page 165).

To devise 'ways and means' to bolster survey response rates as well as to test the social exchange theory in relation to incentive use in survey research, a number of experimental studies have examined the relationship between providing incentives to respondents and survey participation. While some of these studies have focused primarily on the effects of incentives on response rate and item nonresponse (Grove, Couper, Presser, Singer, Tourangeau, Acosta and Nelson 2006; Trussell and Lavrakas 2004; James and Bolstein 1992; Church 1993; Singer 2000; Yammarino, Skinner and Childers 1991; Fox, Crask and Kim 1988), others have examined the effects of incentives on respondent expectations and views about surveys (James and Bolstein 1990; and Singer *et al.* 1998). Consistent with the main proposition of the exchange theory and the norm of reciprocity, many of these studies report a positive relationship between incentives and response rates (Singer *et al.* 2000; Groves, Couper, Presser, Singer, Tourangeau, Acosta and Nelson 2006; Church 1993; Trussell and Lavrakas 2004; Goyder 1982; and Yu and Cooper 1983).

While many studies confirm the importance of incentives in encouraging survey participation, the empirically informed verdict on the relationship between incentives and survey participation is by no means unanimous. In a meta-analysis of experimental and quasi-experimental studies involving incentive conditions, Church (1993) reports that 1% of the studies utilized found no evidence of incentives affecting participation. Church also states that 10% of the 74 studies analyzed actually reported a negative relationship between the incentive conditions and survey participation. In fact, this reality partly prompted Groves *et al.* (2000) to propose the leverage-saliency theory to help explain why "incentives sometimes work" but "sometimes don't" (page 299). Given that findings related to the effects of incentives on survey participation are moderately mixed, as well as the fact that the subject matter of the survey we are studying differs from many previous studies, we find it necessary to

assess incentive effects on survey participation in conjunction with our examination of the relationship between agricultural proximity (our survey's contextual focus) and response. Also, we believe it is important to periodically assess the utility of using incentives in survey research, despite the fact that this subject has received a lot of attention in the past.

Another important incentive-related issue is the potential higher item nonresponse impacts of inducing reluctant respondents to participate in a survey (see Hansen 1980). The potential harm exists in that using persuasions such as incentives might elicit information from respondents who are careless or indifferent when answering questions, ultimately damaging the quality of the information obtained in this way (Singer *et al.* 2000). Owing to this concern, a number of studies have examined the relationship between incentives and item nonresponse, many of which suggest that incentives do not seriously harm response quality; that is, incentives do not generate higher item nonresponse (Singer *et al.* 2000; Singer *et al.* 1998; Shettle and Mooney 1999 and Davern *et al*. 2003). In fact, Singer *et al.* (2000) actually report that prepaid incentives help to reduce item nonresponse, an often-used measure of response or data quality. However, they also report that respondents who received incentives were more likely to give optimistic answers in some cases and be more pessimistic in others (involving different variables). In our case, a critical concern is that urban respondents induced to participate may provide lower quality data (as measured by nonresponse) than respondents more proximate to the agricultural and rural landscape.

In summarizing the review, we find that the research generally suggests that incentives help improve response rates in surveys, with little or no effect on item nonresponse. Although this is generally the case, some findings on the relationship do deviate from this expectation (Church 1993). Also, while many studies find that providing prepaid incentives does not affect item nonresponse, the work of Singer *et al.* (2000) suggests that providing incentives can compromise data quality via the mechanism of optimism or pessimism bias. Given these caveats, as well as the fact that most prior work on the relationship between incentives and survey participation was based on bivariate analysis (incentive and survey participation), we find it necessary to reconsider the impact of incentives on survey nonresponse while taking into account the effects of residential location in space and socioeconomic status. Thus, drawing from this literature on how incentives are related to survey participation and item nonresponse, we make the following hypotheses.

1. Respondents who received incentives will participate in the survey at higher rates than non-recipients, net the effects of proximity to the agricultural and rural landscape and socioeconomic status.
2. Incentives will be negatively related to item non-response. That is, surveys completed by respondents who received incentives will have fewer missing data points than those completed by respondents who did not receive incentives, controlling for the effects of respondents' proximity to the survey's subject and other covariates.

5. Study design

This paper is based on a survey of public views regarding food, agricultural and environmental issues, with a special focus on farm animal welfare. The target population of the survey was Ohio households. An initial sample of 3,000 respondents (along with their residential addresses) was drawn for the study via stratified random sampling: one-half (1,500) from Ohio's 22 core metropolitan counties and the second half (1,500) from the state's 66 metropolitan fringe or non metropolitan counties. The number of households in the core metropolitan counties differed from those in the metropolitan fringe or non metropolitan counties, making the sample a disproportionate random sample. To account for the unequal probability of selection across the two strata, we conducted weighted analysis for this paper.

The sample we used was obtained from Experian, a U.S.-based credit reporting bureau and private list vender. The sample was drawn from a sample frame (database) consisting of Ohio households along with their residential addresses. While we do not pretend that this sample frame covers all Ohio households, we believe that it is one of the most reliable and up-to-date lists and databases in the U.S. from which one can draw a sample. According to Experian, the database is updated monthly.

The survey followed a modified tailored design method (Dillman 2000) with up to four mailings sent to potential respondents during the spring of 2007. The first mailing was a pre-notification letter sent to each sampled unit, followed shortly by the survey packages. The third mailing was a reminder postcard sent to respondents thanking them for participating in the study or encouraging them to complete and return the survey if they had not yet done so. In the fourth mailing, replacement survey packages were mailed to respondents who had not returned completed questionnaires about 10 days after the postcard was mailed out. Of these four contacts with the respondents, three had information that focused specifically on the subject or topic of the survey. The pre-notification letter and the cover letters for the initial and replacement survey packages specifically conveyed to respondents the subject matter of the survey. Also, the graphics printed on the cover page of the survey

(images of farm animals) were selected to further convey this subject matter.

The addresses of sampled units were geo-coded and placed in a locational field (see details later in this section) to locate them geographically across the rural-urban continuum. This allowed us to conduct analyses of how sampled units' proximity to the agricultural landscape is related to their likelihood of participating in the survey. We recognize that some urban residents may have frequent social and physical interactions with agriculture and the rural landscape; however, this kind of interaction, along with its effects on support for agriculture and the environment, is highest among those residing in more rural and open country places (Freudenburg 1991; Sharp and Adua 2009). A randomized experiment involving incentives was also built into the survey. The first survey packages mailed to a randomly-selected half of the sampled units included $2.00 (two one dollar bills) incentives, while the other half of the sample received the same package but without any incentives. In doing this experiment, our pragmatic objective was to assess the effectiveness of our practice of enclosing modest cash incentives in survey packages to improve participation in our ongoing surveys of the Ohio public. Similar to Groves *et al.*'s (2000) expectations about the effect of community involvement on levels of participation, we also anticipated that households located in close proximity to agriculture and the rural landscape would participate at high levels in our study independent of the incentive, perhaps to the extent that a token financial incentive might be deemed unnecessary in future iterations of the survey.

5.1 Analytic strategy

Two sets of statistical analyses are conducted in this paper. The first set of analyses focuses on survey participation (response rate). First, we examine the proportion of successfully contacted sampled units who complete and return surveys by residential location along the rural-urban continuum, a proxy for geographic proximity to agriculture and rural areas of the state (an assumption we justify in a later section), and by incentive status. Following the American Association of Public Opinion Research's (AAPOR) 2008 guidelines for codes disposition, we defined successfully contacted sampled units as (i) those from whom we received completed surveys by the end of the data collection phase of the project, and (ii) those from whom we received neither a completed survey nor the survey package back from the United States Postal Service (USPS) as undeliverable. In our contract with the USPS, we requested that all mails that could not be delivered due to wrong address or absence of forwarding information be returned to us. The sampled units to which these undeliverable mails were addressed were classified as units we were unsuccessful in contacting. We also employ logistic regression to further analyze the likelihood of survey participation (coded 1 = responded; 0 = did not respond), using residential location along the rural-urban continuum and incentive status as the primary predictors, while simultaneously controlling for the effects of socioeconomic status at respondents' block group level as per the 2000 U.S. population census. We control for the effect of socioeconomic status because previous studies suggest it has some relationship with survey participation (Davern *et al.* 2003; Singer *et al.* 2000).

The second set of analyses focuses on item nonresponse. In this analysis, we conduct partial proportional ordered logistic regression analysis (generalized ordered logit) on the first two item nonresponse variables (0 = no missing items; 1 = some missing items; and 2 = numerous missing items), once again employing residential location along the rural-urban continuum and incentive status as the primary independent variables while controlling for the effects of several other variables. Generalized ordered logit (partial proportional odds) is employed rather than ordered logit because some predictors in these models violated the proportional odds assumption of ordered logistic regression. By using partial proportional odds modeling, we are able to constrain the relationship between those independent and dependent variables that met the proportional odds assumption of ordered logistic regression while allowing the relationships that failed this assumption to vary. To analyze the third item nonresponse variables, we employed logistic regression. This variable was recoded into a dichotomy (see the section on operationalization of variables for more details).

5.2 Operationalizing dependent variables

Survey Participation: Survey participation (response rate) is measured by computing the number of completed surveys received from respondents (eligible participating cases) as a proportion of the sampled units contacted successfully (all eligible cases). This measure of survey participation is in conformity with AAPOR guidelines for measuring response rates. Undeliverable surveys returned by the USPS without additional information, such as forwarding address or address correction, were treated as ineligibles. Cases for which we neither received completed surveys nor any other information about the cases from the USPS were treated as eligible based on the recommendation of the AAPOR's 2008 revised standard definitions of codes disposition and outcome rates. To conduct the logistic regression analysis of response likelihood, we coded all successfully contacted sampled units (eligible cases) as 1 (returned a completed questionnaire) or 0 (did not return a

completed questionnaire). We provide no descriptive statistics for this variable here as the analysis section, especially the marginals of the contingency tables, provides a good sense of the distribution of this variable.

Response quality: Response quality is measured by the occurrence of item nonresponse (see Davern *et al.* 2003; and Kaldenberg, Koenig and Becker 1994). To compute item nonresponse, missing data points for all respondents participating in the survey were summed across three subsets of items in the survey instrument to generate three item nonresponse variables: item nonresponse I, item nonresponse II and item nonresponse III. The item nonresponse I variable was created from items that, in our estimation, exerted comparatively the lowest cognitive demand on respondents, including such items as demographics and opinion questions that did not require very much introspection. The item nonresponse II variable was created from items that exerted comparatively higher cognitive demands on respondents than those used to create item nonresponse I, such as questions that required significant recall efforts and opinion questions that required a high level of introspection. The third variable is constructed from items that exerted comparatively the highest cognitive demand on respondents, such as knowledge questions and questions that required some understanding of concepts associated with animal husbandry.

In summing across these variables, we did not treat 'Don't Know' answers as item nonresponse, given that the survey had a couple of knowledge questions for which a 'Don't Know' response could be a legitimate answer. The item nonresponse variable also does not include "refused to answer" responses, as this option was not provided in questions used in the creation of the variables. We also excluded from these variables questions that respondents were directed to skip if they found them to be inapplicable.

Owing to the fact that the distribution of these variables was heavily skewed (see Table 1), the item nonresponse I and nonresponse II variables were regrouped into three ordinal categories (0 = no missing items; 1 = some missing items; and 2 = numerous missing items) and analyzed using generalized ordered logit. The first category (0) included cases without any item nonresponse, while the second category (1) included cases with between 1 and 9 incidences of nonresponse. The third category (2) included cases with 10 or more item nonresponses. For our analysis, we also regrouped the item nonresponse III variable into a dichotomy: 0 (no missing cases) and 1 (1 or more missing cases). This variable was regrouped differently from the first two because very few cases (only 19) satisfied the criteria for classification as "numerous missing cases" (Table 1). To verify whether our regrouping of these variables masked variances in item nonresponse within the groups (cases grouped together) that may be explained by our two independent variables (residential location, i.e. an indicator of interest in the survey topic, and incentives), we conducted a one-way analysis of variance for these grouped cases. Within these groups, none of the three item nonresponse variables varied significantly by residential location or incentives. Descriptive statistics for all three item nonresponse variables are reported in Table 1.

Table 1
Descriptive statistics for item nonresponse variables

	Item nonresponse I	Item nonresponse II	Item nonresponse III
Statistics before recoding			
N	971	971	971
Mean	3.11	2.34	1.6
Standard deviation	5.06	5.93	3.25
Minimum value	0	0	0
Maximum value	44	48	29
Statistics after recoding into groups			
Zero missing	30.07%	59.53%	54.69%
Some missing	62.31%	32.65%	43.36%
Numerous missing	7.62%	7.83%	1.96%

5.3 Operationalizing independent and control variables

Residential Location: The survey's focus on agricultural and environmental issues was made salient during the survey request (via the pre-notification letters, the cover letters and the design of the survey instrument), which can affect participation negatively or positively depending on each respondent's residential location along the rural-urban continuum. Residential location is an indicator of respondents' differentiated social and physical proximity to agriculture and the rural landscape. This is because proximity can increase the social and/or physical interactions with the subject. The association between proximity and environmental concern has been proposed and tested numerous times by social scientists (Dunlap and Heffernan 1975; Freudenburg 1991; Sharp and Adua 2009). We go a step beyond hypothesizing attitudinal differences associated with proximity and anticipate different levels of survey participation; indeed, we hypothesize that sampled units residing closer to agriculture and the rural landscape will participate in the survey at higher rates than those in core urban places. As a result, the subject matter of our survey is expected to serve as a positive leverage on sampled units residing closer to agriculture and the rural landscape. While this may not be a direct measure of leverage, it is consistent with Groves *et al.*'s (2000) suggestion that the leverage a given survey exerts on a sampled unit can be measured indirectly by relying on pertinent characteristics of the

sampled unit. In using the spatial residential characteristics of sampled units, we are relying on the fact that sampled units residing in more rural and open country areas have a higher likelihood of social and physical interaction with the agricultural and rural landscape than those in more urbanized places (see Table 2). In both 2006 and 2007, higher proportions of residents of exurban townships and rural areas (a combination of rural city/village and rural townships) visited a working farm than residents of core urban places, as shown in Table 2. We acknowledge that using information from our own respondents to show the association between residential location and visits to farms may be problematic. However, this information is corroborated by information from a different sample, the 2006 Ohio Survey.

To determine the residential location of the sampled units, each respondent's residential address was geocoded and assigned to one of four location fields – urban, suburban, exurban or rural – using ESRI's ArcView geocoding. Sampled units living in the exurban and rural fields were further distinguished as residing in either incorporated places (city/village) or township places (open country). This process of characterizing sampled units as living in urban, suburban, exurban, or rural places has previously been employed successfully in the field of regional science (Audirac 1999; Sharp and Clark 2008).

In this study, this variable has been grouped into five categories: (1) core urban, (2) suburban places, (3) exurban city/village, (4) exurban township and (5) rural places (cites/villages and townships). The ordering of the categories does not suggest a monotonic increasing order in terms of proximity to agriculture and the rural landscape between categories 1 and 5. Instead, this variable should be seen as a nominal variable with categories that can be grouped into blocks based on proximity to agriculture and the rural landscape: block 1(categories 1 and 2) has the lowest proximity, block 2 (category 3) has intermediate proximity and block 3 (categories 4 and 5) has the highest proximity. Between the blocks, the categories are monotonic increasing in terms of proximity to agriculture and the rural landscape, but within the blocks the pattern is less certain. Here, too, we provide no descriptive statistics for this variable as the analysis section provides an ample sense of how the variable is distributed.

Knowledge of Food Production and Support for Animal Welfare: Two other indicators of survey leverage used in the analysis are two survey items that measured sampled units' knowledge of how their food is produced and their views about the importance of animal welfare. The first asked, "How knowledgeable are you about how your food is grown? Please indicate on a scale of 1 to 7 your level of knowledge." This item had a mean of 4.47 and a standard deviation of 1.60. The second item asked, "Thinking about farm animals in general, how important is this issue to you? Please indicate on a scale of 1 (not important) to 7 (very important)." This item had a mean score of 4.50 and a standard deviation of 1.68. These two indicators are used in analyses pertaining only to the item nonresponse variables.

Incentive Status: Sampled units' incentive status (received versus did not receive incentive) is a primary independent variable in the regression models. Incentive status is dummy-coded as 0 (did not receive incentive) and 1 (received incentives). Again, we provide no descriptive statistics for this variable because the analysis provides a good sense of the variable's distribution.

Control Variables: Control variables operationalized in one or more of the analysis conducted in this study include *Age* (respondent's age as of his/her last birthday), *Education* (highest level of education completed), *Ethnicity* (white = 1; all others = 0) and *Gender* (male = 0 and female = 1), as well as the per capita and disposable median household income of each sampled unit's block group as per the 2000 population census. We control for the effects of these variables because previous studies suggest they can affect item nonresponse (Davern *et al.* 2003; Singer *et al.* 2000). Descriptive statistics for these purely control variables are shown in Table 3.

Table 2
Frequency of visiting or touring a working farm

	2006 Ohio Survey[a]			2007 Animal Welfare Survey[b]		
Residential location	**Never/ seldom**	**Occasional/ frequently**	**Total[c]**	**Never/ seldom**	**Occasionally/ frequently**	**Total[c]**
Core urban	90.4%	9.6%	100% (185)	81.0%	19.0%	100% (121)
Suburban place	87.5%	12.5%	100% (536)	83.7%	16.3%	100% (285)
Exurban city/village (Incorporated)	78.6%	21.4%	100% (217)	76.4%	23.6%	100% (124)
Exurban township (Unincorporated)	74.9%	25.1%	100% (434)	67.9%	32.1%	100% (264)
Rural place	73.1%	26.9%	100% (238)	70.6%	29.4%	100% (136)
Total	80.6%	19.4%	100% (1,610)	74.2%	25.8%	100% (930)

[a] Second-order corrected chi-square (3.61) = 43.3; $P = 0.0000$ (corrected for survey design effects)
[b] Second-order corrected chi-square (3.67) = 16.7; $P = 0.001$ (corrected for survey design effects)
[c] In parentheses are the total number of eligible cases from each residential category.

Table 3
Descriptive statistics for control variables

	Mean/percent	Standard deviation
Education:		
High school and lower	36.8%	-
Some college	32.3%	-
Bachelor's degree	13.7%	-
Grad/professional work & higher	17.2%	-
Gender:		
Male	48.2%	-
Female	51.8%	-
Ethnicity:		
White	91.7%	-
Non-white	8.3%	-
Age:	51.9	15.8
Block level mean household income, 2000	49,842.3	25,258.7
Block level median household income, 2000	42,616.3	16,728.6

6. Results

To evaluate survey participation, we use both bivariate analysis (contingency tables) and logistic regression modeling. For the contingency tables, we use Pearson chi-squared statistics corrected for survey design with Rao and Scott's (1984) second-order correction. We do this because survey design features such as stratification and clustering can affect tests of association (Lohr 1999). To limit the length of this paper, we follow a different analytical plan for the item nonresponse set of variables. For this set, we conduct only multivariate analysis (logistic regression). Moving straight to multivariate analysis allows us to examine the partial effects of the various predictors used in the models while keeping the paper brief.

6.1 Bivariate results for survey participation

The bivariate analysis suggests that survey participation varies significantly by proximity to the agricultural and rural landscape (residential location along the rural-urban continuum). As shown in Table 4, respondents residing in geographically more rural places (rural and exurban township residents) have higher rates of participating in the survey than those residing in geographically more urban places (core urban and suburban residents). The analysis also shows that those in the intermediate exurban incorporated places (cities and villages) were slightly more likely to participate than core urban residents. A second-order corrected chi-square test (Rao and Scott 1984) of the relationship between survey participation and residential location was significant ($\chi = 14.2$; df = 3.7; and $p = 0.003$).

Our analysis is consistent with previous studies, also finding that prepaid incentives significantly increase survey participation (Table 5). Despite the fact that the context of the survey used for our analysis differs markedly from previous studies examining the effects of incentives, we find that the response rate for successfully contacted incentive recipients was 43.7% compared with 26.9% for successfully contacted sampled units who did not receive prepaid incentives. The second-order corrected chi-square test of this bivariate relationship is also statistically significant ($\chi = 73.8$; df = 1; $p = 0.000$). In fact, our analysis suggests that eliminating incentives altogether substantially hurts participation rates for all categories of respondents regardless of proximity to the agricultural and rural landscape, although this effect is highest for residents in core urban places (Table 6). This finding provides support for our ongoing practice of using prepaid monetary incentives to help bolster our response rates with no discrimination between whether respondents reside in rural or urban locales. It also reaffirms the importance of incentives in survey research.

6.2 Logistic regression model for survey participation

Multivariate analysis further suggests that the likelihood of survey participation varies significantly by proximity to agriculture and the rural landscape, statistically holding constant the effects of incentive status (received versus did not receive incentive). Residents of suburban places, exurban townships, and rural places are significantly more likely to participate in the survey than residents of core urban places (Table 7). For example, residents of exurban townships and rural places have higher odds (0.60 log odds and 0.37 log odds, respectively) of participating than those of core urban places.

Table 4
Participation rate by residential location

Residential location	Responded	Did not respond	Total[a]
Core urban	29.5%	70.5%	100% (424)
Suburban place	32.6%	67.4%	100% (917)
Exurban city/village (Incorporated)	33.1%	66.9%	100% (379)
Exurban township (Unincorporated)	40.5%	59.5%	100% (684)
Rural place	35.8%	64.2%	100% (405)
Total	35.4%	65.6%	100% (2,809)

Second-order corrected chi-square (3.7) = 14.2; $P = 0.003$ (corrected for survey design effects)
[a] In parentheses are the total number of eligible cases from each residential category

Table 5
Survey response by incentive status

Incentive status	Responded	Did not respond	Total[a]
Incentive	43.7%	56.3%	100% (1,410)
No incentive	26.9%	73.1%	100% (1,401)
Tota1	35.4%	64.6%	100% (2,811)

Second-order corrected chi-square (1) = 73.8; $P = 0.000$ (corrected for survey design effects)
[a] In parentheses are the total number of eligible cases by incentive status

Table 6
Response rate by incentives and residential location along the rural-urban continuum

	Incentive recipients	Non-recipients of incentive	Response difference
Core urban	0.41	0.19	0.22
Suburban place	0.41	0.24	0.17
Exurban city/village (Incorporated)	0.39	0.27	0.12
Exurban township (Unincorporated)	0.48	0.31	0.17
Rural place	0.44	0.27	0.17
Total	0.43	0.26	0.17

Logistic regression analysis also seems to confirm our earlier finding that the likelihood of participating varies significantly by whether or not a sampled unit received incentives. Respondents who received incentives had higher odds (0.73 log odds) of participating in the survey than those who did not receive incentives, controlling for proximity to agriculture and the rural landscape as well as the gender (female = 1) of the householder randomly assigned as the preferred household member to complete and return the survey (Table 7).

Because socioeconomic status varies significantly by residential location across space (Lobao 1990) and affects survey response (Davern *et al.* 2003; Singer *et al.* 2000), we endeavored to control for the potential effects of per capita income and household income (socioeconomic status) on the likelihood of survey participation using hierarchical linear modeling (HLM). To do this, respondents were linked to their block groups and block group characteristics (specifically, block group per capita income and block group household median income) as per the 2000 U.S. population census. For the HLM analysis, we initially estimated a fully unconditional model (that is, an ANOVA) to determine whether the likelihood of survey participation varied significantly across the block groups. In hierarchical linear modeling, estimating a fully unconditional model (model without predictors at all levels of the analysis) is typically used to determine whether the dependent variable varies by the level two (or higher) unit of analysis, such as a neighborhood, block group or school district. This initial model (ANOVA) often helps researchers determine whether to proceed with multi-level analysis. Our initial HLM analysis (ANOVA) did not reveal any significant variation in the likelihood of survey participation across the block groups (tau = 0.04; $p = 0.493$). While this finding suggests the average probability of survey participation is about the same for all block groups despite their different per capita

and household disposable median incomes, we acknowledge potential instability in this HLM model given that sample cases per block group were generally low. This may have led to our finding of no significant variation in the likelihood of participation across the block group (potential Type II error). Despite this potential problem with our fully unconditional model, we did not proceed with the fully conditional multi-level analysis.

6.3 Logistic regression model for item nonresponse

As noted earlier in this section, our analysis of item nonresponse is limited to multivariate modeling, and we do this primarily to keep the paper brief while achieving our objective of assessing the partial effects of our main independent variables. The data suggest that the anticipated leverage of the survey's subject is only modestly related to item nonresponse. With respect to item nonresponse I (that is, the variables created from questions with the least cognitive demand on respondents in the survey), the analysis suggests that respondents in exurban township areas have lower item nonresponse (-0.74 log odds) than those residing in core urban areas, although this difference disappears at the higher values of this variable (Table 8, Columns 2 and 3). However, for item nonresponse II (the item nonresponse variables created from questions more cognitively demanding than those used in item nonresponse I) we find that residents of exurban townships and rural places are more likely to have higher item nonresponses (0.85 and 0.82 log odds, respectively) than residents of core urban areas (Table 8 Column 4). In terms of item nonresponse III (the item nonresponse variables created from the most cognitively demanding questions), the analysis did not reveal any significant difference by residential location, our proxy for level of interest in the survey's topic.

Supporting the anticipated effect of interest in a survey's topic on item nonresponse, the analysis also suggests that respondents' knowledge of how food is produced is significantly related to item nonresponse. In terms of item nonresponse II, the data shows that respondents who reported knowing how food is produced have lower log odds (-0.13) of item nonresponse than those who reported having less knowledge of how food is produced (Table 8, Column 4). This relationship is stronger at higher values of the variable: knowledge of how food is produced has lower log odds (-0.35) of item nonresponse when the category value shifts from 0 to 1 (Table 8 Column 5). This result suggests that the positive leverage of the survey's topic may have resulted in greater care in the completion of the survey among respondents with greater knowledge of how food is produced. We also find that respondents' views about the importance of animal welfare, a central subtheme of this particular survey, are positively related to item nonresponse (Table 8, Column 4). As shown in Table 8, a one unit increase in viewing animal welfare as important leads to a 0.09 unit increase in the log odds of item nonresponse (specifically item nonresponse II). This finding is inconsistent with our expectations.

In terms of the effects of incentives, we find no significant relationship between incentives and any of the three measures of item nonresponse (Table 8, Columns 2, 4 and 6), contrary to our expectation.

Table 7
Logistic regression[a] of likelihood of participation

	Log odds of participation	
	b	**Std. Error**
Incentive status		
Did not receive incentive (Ref)		-
Received incentive	0.73***	0.09
Residential location		
Core urban residents (Ref)	-	-
Suburban residents	0.27*	0.13
Exurban city/village residents	0.25	0.15
Exurban township residents	0.60***	0.13
Rural residents	0.37*	0.15
First option to respond (Female = 1)	-0.05	0.09
Model statistics		
Intercept	-1.42***	
Wald χ (df = 6)	93.25***	

Significance: ***< 0.001; **< 0.01; and *< 0.05

[a] In this model we tested for potential interaction effects between residential location and incentives. We found no evidence of such an interaction effect.

Table 8
Logistic regression models[a] for item nonresponse

	Item nonresponse I[b]		Item nonresponse II[b]		Item nonresponse III[c]
	No missing: log odds	Some missing: log odds	No missing: log odds	Some missing: log odds	Log odds
Incentive status					
Did not receive incentive	-				
Received incentive	0.16		0.10		-0.01
	(0.16)		(0.17)		(0.17)
Subject salience –Residential location					
Core urban residents	-				
Suburban residents	-0.14		0.54		-0.18
	(0.26)		(0.29)		(0.25)
Exurban city/village residents	-0.36		0.30		-0.24
	(0.31)		(0.34)		(0.29)
Exurban township residents	-0.74**	0.30	0.85**		-0.12
	(0.27)	(0.40)	(0.30)		(0.26)
Residents of rural places	-0.21		0.82**		0.08
	(0.3)		(0.31)		(0.29)
Subject salience –Food knowledge and animal welfare					
Knowledge about how food is produced	-0.07		-0.13*	-0.35***	-0.02
	(0.05)		(0.05)	(0.09)	(0.06)
Importance of animal welfare	0.10		0.09*		0.10
	(0.05)		(0.04)		(0.05)
Controls					
Education:					
High school and lower					
Some college	-0.79***		0.13		0.07
	(0.20)		(0.19)		(0.19)
Bachelor's degree	-1.08***		-0.32		-0.52
	(0.23)		(0.27)		(0.29)
Grad/professional work & higher	-0.99***		0.12		-0.38
	(0.24)		(0.24)		(0.24)
Age	0.03***		0.04***		0.03***
	(0.01)		(0.00)		(0.01)
Gender (Female = 1)	0.03		0.53**		0.21
	(0.17)		(0.17)		(0.17)
White	-0.38		-0.05		-0.51
	(0.32)		(0.28)		(0.32)
Model statistics					
Intercept	0.16	-4.36	-3.56	-5.07	-3.07
Wald chi-square[d]	85.80		93.25		54.87
N	828		828		828

Significance: ***< 0.001; **< 0.01; and *< 0.05
Standard errors shown in parentheses.
[a] We tested for potential interaction effects between residential location and incentives, between age and incentives and between ethnicity (white) and incentives in these models following Singer *et al.* (2000). We found no evidence of such interaction effects.
[b] The item nonresponse I and II models are partially constrained proportional odds logit models. This is because some of the predictors of these models violated the parallel lines assumption. These predictors were thus allowed to vary, while the remaining ones were constrained. William's (2006) gologit2 stata program code was used to estimate the model.
[c] This model is a logistic regression model with a binary dependent variable (variable recoded into two categories).
[d] Degrees of freedom are 14, 14, and 13 for the low cognitive, mid cognitive, and high cognitive models, respectively.

In terms of the control variables, we find that education is significantly related to item nonresponse, which is consistent with the earlier findings of Singer *et al.* (2000). In our case, respondents with some college work, a bachelor's degree, or some graduate/professional work have lower odds (-0.79, -1.08, and -0.99 log odds respectively) of missing cases for the survey questions with the lowest cognitive demand (item nonresponse I) than those with only a high school education or less (Table 8, Column 2). Surprisingly, item nonresponse related to the survey questions that were comparatively higher in cognitive demand (that is, item nonresponse II and item nonresponse III) did not differ by education (Table 8, Columns 4 and 6). We also find positive relationships between age and all three measures of item nonresponse (Table 8, Columns 2, 4, and 6), which is consistent with *Singer et al.* (2000). Equally consistent with the earlier work of Singer *et al.* (2000), the analysis reveals that female respondents are more likely to have missing data points than male respondents (Table 8, Column 4). However, the effect of gender on item nonresponse in our study is limited to those survey questions with a medium level of cognitive demand (the item nonresponse II variable).

7. Discussion and conclusions

In this study, we examined factors related to both unit and item nonresponse in survey research, focusing on interest in a survey's topic and prepaid incentives. The obvious reason for carrying out this analysis is the fact that nonresponse (unit or item) represents a major challenge to survey research given its potential for generating non-sampling errors in parameter estimates (Brehm 1993; Dillman *et al.* 2002; Groves and Cooper 1998). As previously noted, nonresponse can lead to biased point estimators, variance inflation for point estimators, and biases in estimators of precision (Dillman *et al.* 2002; Groves and Cooper 1998). Therefore, our primary goal is to provide information that will help researchers understand and deal appropriately with nonresponse, that is, minimize unit nonresponse and correctly understand and handle missing cases (item nonresponse).

Our analysis reveals that the likelihood of participation in this survey on agriculture and the environment varies significantly by sampled units' proximity to the agricultural and rural landscape (residential location). Our analysis is consistent with our first hypothesis and the theoretical proposition of leverage-salience, as we find that residents of exurban townships and rural places are all significantly more likely to participate in the survey than residents of core urban places. The pattern of relationships revealed in this analysis is most likely explained by the fact that respondents residing in exurban townships and rural places have a higher chance of interacting with the agricultural and rural landscape than those residing in core urban places (see Table 2). Thus, we suggest that respondents residing closer to the agricultural and rural landscape participated at higher rates in the survey due to the positive leverage of the survey's focus on the agricultural and environmental domain.

We also find some relationship between interest in the survey's topic (measured by proximity to the agricultural and rural landscape) and response quality (measured by item nonresponse). In support of our second hypothesis, modest evidence in this study suggests that item nonresponse varies by proximity to the agricultural and rural landscape. For item nonresponse I, the data suggest that residents of exurban township areas are less likely to have missing data points than residents of core urban places, whereas residents of both exurban townships and rural places are more likely to have missing data points for item nonresponse II. Missing cases associated with questions with the highest cognitive demand (item nonresponse III) did not vary by residential location (interest in the survey's topic). These findings suggest that residents of the more rural places (exurban townships and rural places) fare worse than those of core urban places when missing cases involve survey questions with a moderate level of cognitive demand. Although this result is intriguing, we are unable to explain why it is the case. One possible argument would be the educational difference between residents of core urban and rural places, but this study statistically controls for the effects of education. Further work certainly needs to be done on this subject.

Knowledge of how food is produced, another indicator of proximity to agriculture and the rural landscape, is negatively related to item nonresponse, which is consistent with our expectation (hypothesis 3) and the leverage-saliency theory. As the knowledge of how food is produced is related to the broader topic of the survey, we believe that making the survey's focus on agriculture and the environment salient in our request for participation in the survey may have generated higher diligence in questionnaire completion among respondents who knew or cared enough to know how food is produced. However, our analysis also suggests that support for animal welfare is positively related to item nonresponse, which is inconsistent with hypothesis 3. These findings highlight the need to look closely at factors related to a survey's topic as potential covariates of item nonresponse and its corollary, nonresponse error.

Although the survey used in this study focused on agriculture and the environment, our findings in relation to the survey's topic may have implications for surveys that focus on other sectors. There is reason to believe that unit

and item nonresponse can be affected by respondents' proximity to or level of interest in any survey topic or industry of focus, especially if this aspect of the survey is made salient during the request for participation. For example, if a survey focuses on the automotive industry and this feature is made salient during the request for participation, it is very likely that this information will affect the response pattern. In essence, these findings suggest that researchers designing surveys need to think critically about how the survey's subject context, such as the industry or sector on which it focuses, might affect participation from subpopulations within the sample list. While this generalization may be reasonable, we believe similar studies focusing on other sectors will be required before we can draw firm conclusions.

We next discuss the relationship between prepaid incentives on the one hand and survey participation and item nonresponse on the other. With respect to the relationship between incentives and response, our study suggests that prepaid incentives generally increase the likelihood of a respondent participating in a survey, even if proximity to agriculture and the rural landscape (the survey subject context) is taken into account. Our findings are consistent with hypothesis four and the previous literature (Singer *et al.* 2000; Groves 2006; Church 1993; Trussell and Lavrakas 2004; Goyder 1982; and Yu and Cooper 1983), as they show that recipients of prepaid incentives were significantly more likely to participate in the survey than non-recipients, controlling for other variables in the logistic regression model. The analysis demonstrates that eliminating incentives altogether hurts the likelihood of participation regardless of respondents' residential context. While we may not have overtly identified prepaid incentives with the leverage-saliency theory of Groves *et al.* (2000) in the earlier sections of our discussion for the sake of analytical convenience, our findings in relation to this variable also provide further empirical support for this theory. Our findings clearly suggest that token financial incentives enclosed with each survey package helped increase participation from both metropolitan and non-metropolitan areas of Ohio, although this effect was higher in the former. This result provides fresh justification for the widespread use of incentives to bolster response rates. As indicated earlier in this paper, the widespread use of prepaid incentives in surveys makes it necessary to periodically assess the utility of this practice. Our finding also suggests the need to check for potential response bias if incentives are provided to only a section of the sampled respondents, such as when prepaid incentives are targeted at those assessed as being less likely to participate.

In terms of the relationship between incentives and item nonresponse, we find no significant variation in missing data points between respondents who received monetary incentives and those who did not, contrary to our fifth hypothesis. This finding, which controls for the effects of residential location (proximity to the agricultural and rural landscape) and other pertinent variables, is consistent with the earlier work of Davern *et al.* (2003), who failed to find any relationship between incentives and the number of imputations for missing data points. Thus, while the use of monetary incentives correlates significantly with unit nonresponse (outright nonparticipation in a survey), we find no relationship between incentives and item nonresponse (failure to respond to some questions on a questionnaire). Thus, providing incentives to a respondent does not necessarily lead to greater diligence in survey completion.

The analysis revealed some interesting results with respect to the relationship between some of the control variables and item nonresponse. While education, age and gender were used in this study primarily as control variables, the fact that they were found to be significantly related to item nonresponse raises practical concerns about handling missing cases in survey data. Before choosing between the various techniques for handling missing cases (see Fuchs and Kenett 2007), analysts will need to check for potential nonresponse bias resulting from the effects of these variables, especially if they will be part of an analysis.

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