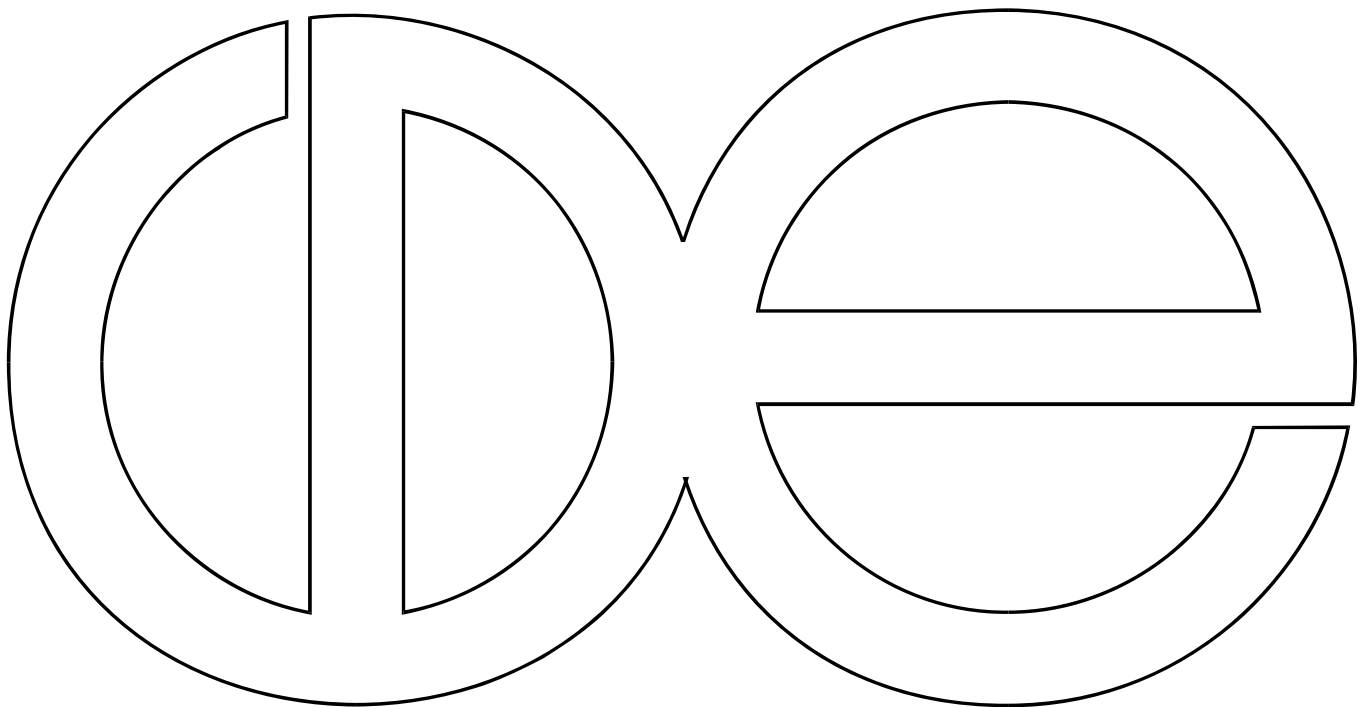


**Center for Demography and Ecology
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**Cognitive Skills and Survey Nonresponse:
Evidence from Two Longitudinal Studies**

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**COGNITIVE SKILLS AND SURVEY NONRESPONSE:
EVIDENCE FROM TWO LONGITUDINAL STUDIES**

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ABSTRACT

This study examines the relationship between general cognitive skills (i.e., those measured by intendedly general tests of ability or aptitude) and cooperation with requests for continued participation in longitudinal studies. Using the Wisconsin Longitudinal Study (WLS) of 1957 high school graduates, I find a consistent monotonic relationship in which those with higher measured skills are less likely to refuse to participate. Analyses indicate that this result cannot be explained by family background measures and is only slightly attenuated by the inclusion of measures of subsequent educational and occupational attainment and social participation. Meanwhile, in the 1998 wave of National Longitudinal Study of Youth in 1979 (NLSY79), the opposite relationship is observed: those with higher cognitive skills are somewhat *more* likely to refuse to participate. Further analyses reveal that this is due to some aspect of refusal conversion, as the pattern of initial refusals in the NLSY79 is similar to that of ultimate refusals in the WLS. One important difference between the refusal conversion efforts in the two studies is that NLSY79 has used significant financial incentives and WLS does not, which may explain the difference.

The reservoir of public availability and goodwill that has served to irrigate the field of survey research is becoming ever shallower, as survey researchers continue to have increasing difficulty securing respondent participation. The generalizability of sample survey results is undermined to whatever extent pertinent characteristics of respondents and outcomes under investigation are each systematically associated with such refusals. Accordingly, understanding systematic predictors of survey refusals is a matter of increasing practical import, both for assessing implications for estimates and considering possible ways of improving response rates. Conceptual work toward theories of survey participation has emphasized that associations of sociodemographic characteristics likely often reflect antecedent or intervening psychology (e.g., Groves and Couper 1998), but relatively few studies have directly examined the relationship between basic psychological characteristics and cooperation with survey participation requests.

This study considers the relationship between general cognitive skills (e.g., those measured on intendedly general skills tests) and refusing to participate in surveys. Cognitive skills already figure heavily in theories of survey response. Krosnick (1991; Anand and Krosnick 2004) proposes that those with lower cognitive skills are more likely to "satisfice" in their responses, i.e., put less cognitive effort into their response to any particular survey question. Among the empirically supported implications of this reasoning is that cognitive skills can be expected to be associated with "don't know" and related item nonresponse (Krosnick 2002). From this, one could speculate that an even more complete way of minimizing the cognitive demand of surveys might be to refuse to participate in the first place.

For that matter, cognitive skills are implicated in theoretical relationships between cognitive skills and civic or prosocial engagement (Nie, Junn and Stehlik-Barry 1996; Wilson

2000), and academic surveys typically (and perhaps often exclusively) appeal to prosocial motives in attempting to convince individuals to participate. A relationship between higher cognitive skills and higher survey participation is further suggested by associations between education and survey participation that has been found in some studies (see Groves and Couper 1998: 128), although education has many noncognitive correlates and consequences and thus associations between education and an outcome cannot be straightforwardly interpreted as due to cognitive differences. Considering whether and possibly why cognitive skills are related to nonparticipation may help construct solicitations that reduce the relationship and thus improve the representativeness of surveys.

Researchers can only study characteristics of nonrespondents when they have some means of obtaining or inferring information about these individuals other than the survey in which they did not participate. Longitudinal studies offer the possibility of studying refusal in later waves using information in earlier waves. The ideal longitudinal study in this respect may be one that has a “captive audience” for its first wave, so that the initial sample can be regarded as a complete representation of some well-defined population. Of course, attrition from such studies should not be confused with refusal to participate in a survey with which one has no previous relationship. In any case, such longitudinal studies are rare, and even fewer have obtained respondent scores on tests intended to measure general cognitive skills. I use the Wisconsin Longitudinal Study, a cohort sample which exemplifies this design. Then, I seek to corroborate the basic finding using a much different sample, the National Longitudinal Study of Youth in 1979 (NLSY79), and instead find contrary results. The discrepancy prompts further exploration of why the studies might differ in the relationship between cognitive skills and

respondent willingness to participate, which points to the possibility that cognitive gradients in longitudinal surveys may be attenuated by incentives.

WISCONSIN LONGITUDINAL STUDY

The WLS began as a questionnaire about future plans administered to all Wisconsin high school seniors graduating in 1957. From this census, investigators later drew a 1/3 random sample (N=10,317) that has provided the basis for later surveys. Subsequent surveys have been conducted in 1964 (mail to parents), 1975 (phone), 1993 (phone and subsequent mail survey of phone respondents), and 2004 (phone and mail). Reflecting the composition of 1957 Wisconsin high school graduates, WLS sample members are almost entirely white and of course are all approximately the same age (~65 years old in 2004) and all have at least a high school diploma. The WLS asks questions about many different domains of respondents' lives, but survey content has focused most prominently on finances, respondents' work history, marital and fertility history, educational attainment, and health, while relatively few questions have asked about political or social attitudes (Wisconsin Longitudinal Study 2006).

Cognitive skills in the WLS were measured using the Henmon-Nelson test of Mental Ability (hereafter HN), an intendedly general aptitude test that was administered during respondents' freshman and junior years and obtained from the Wisconsin State Testing Service. I use respondents' normalized and standardized junior year score when available and their adjusted freshman year score otherwise. Although cognitive skills should not be considered immutable over the life course, general measures do empirically exhibit very high rank-order stability over midlife relative to other basic psychological characteristics (Schaie 1996).

Table 1 presents data on noncontact, telephone survey refusal, and mail survey nonreturn rates for the 1975, 1992, and 2004 waves of the WLS. Refusal rates are conditional on the respondents' household being contacted, and nonreturn rates are conditional on a mail survey being sent. Rates are provided for the bottom, middle, and top quintiles of the distribution of cognitive skills scores in the sample. Marginal effects are also included; these are the change in probability of refusal associated with a standard deviation increase in cognitive skills score evaluated at its mean. While noncontact rates are not the focus of this study, we note that noncontact is inversely associated with cognitive skills, which is expected given that respondents with low education are typically harder to find in longitudinal studies. This result for noncontacts is also significant in logistic regression models using the same covariates as in the analysis of refusals presented later (all $p < .01$; not shown).

TABLE 1 ABOUT HERE

Looking at the telephone refusal rates, we can see that in 1975, 6% of contacted respondents in the lowest test score quintile refused to participate in the survey, as opposed to 2% of respondents in the top quintile. That respondents in the middle quintile refused at rates between these two percentages prefigures a more general pattern for nonparticipation in this sample: the relationship between cognitive skills and nonparticipation is a monotonic *gradient* across the observed range of ability, as opposed to only reflecting a higher propensity for nonparticipation among the lowest scoring respondents. In 1992, refusal rates were higher overall, but refusal rates among the lowest scoring quintile (10.4%) remained almost three times larger than for those in the highest quintile (3.2%).

Enough respondents did not participate fully in 1992 that, for 2004, we can stratify the data according to whether respondents completed both the 1992 phone and mail survey,

completed the 1992 phone survey but did not return the mail survey, or did not participate in 1992. Among those who participated fully in 1992, refusals in 2004 also occurred at roughly three times the rate for those in the lowest quintile (12.2%) as the highest quintile (4.1%). A similar pattern is observed among those who did not return the mail survey. For nonparticipants in 1992, meanwhile, solicitations in 2004 were equally ineffective regardless of cognitive skills.

General cognitive skills are also related to mail survey participation. In 1992, respondents were only sent the mail survey if they completed the telephone survey. Consequently, any observed cognitive gradient in mail participation is *in addition to* the cognitive differences observed for 1992 telephone survey participation. Nonetheless, 24.8% of those in bottom test score quintile did not return the mail survey, compared to only 11.4% of those in the top quintile.

In 2004, despite a doubling of the length of the mail survey (from 24 to 50 pages), mail survey participation among those who had completed the phone survey actually increased from 1992. This was perhaps due to the inclusion of a \$10 incentive with the initial mailing, which was the first use of monetary incentives in the WLS. Refusal rates were again inversely associated with cognitive skills, although note that the relative difference between the top and bottom quintiles was lower. If literacy or linguistic burden was responsible for the cognitive gradient in the WLS, one might expect the lengthening of the mail survey to increase the cognitive gradient; that the gradient appears to have decreased instead raises the possibility that the addition of the incentive was differentially effective among those with lower cognitive skills.

Two questions prompted by these results are the extent to which the associations with cognitive skills may reflect the spurious influence of socioeconomic status of respondents' family of origin, and the degree to which the associations are resolved by the effect that

cognition has on subsequent educational or occupational attainment. Because participation in 1975 was so high, I use information obtained in 1975 and earlier to study participation in 1992 and 2004. As measures of family background, family income in 1957 is measured from administrative tax records. Parental education and occupation (1970 Duncan SEI) in 1957 are based on the respondent's 1975 report. As measures of post-high school attainment, educational attainment (in years) and occupational prestige (1970 Duncan SEI) are based on the 1975 survey. Given the earlier results, 2004 phone participation is examined conditional on 1992 phone survey participation, and 2004 mail participation is also conditional on 2004 phone survey participation.

Table 2 includes results for a model with respondent's sex and family background characteristics (Model 1) and a model that adds educational attainment, occupational prestige in 1975, and social participation in 1975 as measured by number of reported organizational memberships (Model 2; see Hauser 2005 for discussion of social participation as covariate). The coefficient for the simple bivariate logistic regression of the outcome on HN score is included for reference at the bottom of the table. The most basic result is that cognitive skills have a strong relationship on survey participation that persist net of all these variables.

TABLE 2 ABOUT HERE

If we compare the results for cognitive skills in Model 1 to the bivariate coefficients, we can see that the addition of family background controls and respondent's sex makes little difference. Indeed, the estimates for cognitive skills increase in size for two of the four outcomes. These results indicate that the apparent effect of cognitive skills appears not at all accounted for by respondents' family backgrounds.

The addition of education and occupation yields modest decreases in the estimated direct effect of cognitive skills on telephone refusal in both 1992 and 2004, but has little consequence

for nonreturn of the mail surveys. The attenuation that is observed is almost entirely due to educational attainment, which shows a significant effect on telephone participation in its own right.¹ In other words, subsequent educational attainment seems to have only a very modest role in explaining why adolescent cognitive skills are so strongly related to the propensity of WLS respondents to refuse to participate when in their mid-fifties (1992) or mid-sixties (2004) (these results are consistent with Hauser's [2005] analysis of the 1992 wave only). On the other hand, prior cognitive skills does account for a substantial part of the apparent relationship of education on WLS participation, especially for the mail surveys.

A different issue we considered was whether the surveys appear to impose different time burdens for participants, which might be taken as suggestive of the surveys being generally more taxing for respondents of lower cognitive skills. In both 1992 and 2004, respondents in the highest quintile actually took slightly longer to finish the phone survey than respondents in the lowest quintile (63.0 vs. 59.7 minutes in 1992; 76.3 vs. 74.6 minutes in 2004). This appears due to higher-scoring respondents following longer skip patterns through the survey (e.g., in the questions about assets). In 1992, a set of items measuring personality and psychological well-being included no skip patterns; the average length of time to complete these items decreased as cognitive skills increased (ranging from 4.41 minutes for the highest quintile to 4.75 minutes for the lowest quintile). For both the 1992 and 2004 mail survey, respondents in the lowest quintile reported taking substantially longer to complete the instrument (means of 36.0 vs. 49.1 minutes in 1992, and 115.9 vs. 140.5 minutes in 2004). Regarding the possibility that anticipation of this differential burden explains the difference in willingness to participate, I did not observe any

¹ The observed coefficients of having some college and having a college degree on phone participation in 1992 and 2004 are about a third smaller than the coefficients in models that exclude HN scores but otherwise include the same covariates as Model 2 (see also Hauser 2005).

evidence of an independent relationship between time to complete any survey and refusal to participate in a subsequent survey, and thus these differences per se cannot account for any of the observed cognitive gradient in willingness to participate.

The bias in empirical work resulting from an inverse cognitive gradient in refusals depends on the relationship between cognition and both the characteristics and outcomes of interest. Even those critical of an overemphasis on cognitive test scores in some settings still acknowledge substantial relevance of these scores for a wide variety of outcomes (e.g., Fischer et al. 1996). Even so, the consequentiality of the gradient reported here should not be overstated. The mean test score among only respondents with a complete record of response is only about .14 SD (approximately 1 IQ point) higher than the mean for all respondents who were not deceased in 2004. The proportion of WLS respondents who ever attended college is estimated as 44.8% from the sample who completed all surveys, compared to 40.9% estimated from all nondeceased WLS respondents provided information about educational attainment in 1964 or 1975. The difference in the correlations between father's education (as reported by the student in 1957) and respondent years of education is .324 when analyzed with only respondents with complete participation and .341 for all respondents. Assessments of the consequentiality of biases of these magnitudes depend on the precision demanded by particular investigations.

NATIONAL LONGITUDINAL STUDY OF YOUTH IN 1979

One might wonder whether the above results are unique to the WLS. For this reason, I turned to the NLSY79. NLSY79 is based on a national sample of Americans who were 14-22 in 1979 (see CHRR 2004 for a detailed discussion of the sampling and fielding of NLSY79). Like the WLS, the NLSY79 asks questions about a large number of different domains, but focuses

most prominently on economic, familial, educational, and health outcomes, and it contains relatively few questions about political or social attitudes (CHRR 2004). I use only the NLSY79 sample that was drawn as a fully representative panel of its cohorts (called the “cross-sectional sample”), although the substantive results do not change when the study’s supplemental samples are included. The survey did not have a “captive audience” for its first wave, but 90% of those designated for interviewing in the cross-sectional sample participated (N=6,111 of 6,812). NLSY had surveyed respondents either in person (preferentially for most waves) or by phone annually until 1994 and biennially since. Analyses here will focus on the 1998 NLSY, which at the time the main analyses were first conducted was the most recent wave in complete public release. In 1998, 5,159 of 5,840 attempted cases were completed (88.3%), with 490 respondent refusals (8.4%).

Cognitive skills in the NLSY79 were measured in 1980, the year after the first wave of the survey, through a special administration of the Armed Services Vocational Aptitude Battery (ASVAB) in which 94% of respondents participated (see NLSY79 [n.d.] for considerable general and technical information on the administration of this test in the study). As with the HN test, the ASVAB was intended as a general measure of cognitive skills. I use the NLSY79 transformation of ASVAB results into the 1989 revision of the Armed Forces Qualifying Test score (AFQT) (CHRR 2004). For the regression-based analyses below, I include dummy variables for cohort to account for the different ages of NLSY79 respondents when the test was administered.

Table 3 presents refusal rates for the 1998 NLSY for all contacted respondents, and also divides these results by whether or not the respondent participated in the previous wave of the study. Looking at the first row of the table, we see exactly the opposite of the pattern observed

for the WLS: respondents with higher cognitive test scores were *more* likely to refuse to participate in the NLSY79 survey. In all, refusals were almost twice as common among those in the highest quintile (9.5%) than the lowest quintile (5.0%). This result is not at all attenuated in a logistic regression model that includes controls for parents' prior or respondents' subsequent education (marginal effect of test score at mean = .014 for model with test scores and cohort, .015 for a model also adding years of mother's and father's education as available, and .016 for a model also adding respondent's own years of education). As the last two rows of the table indicate, those with lower cognitive skills are underrepresented among those for whom complete data is available over the 18 waves from 1979 to 1998, but this difference is entirely attributable to noncontacts of one kind or another and is not the result of cognitive differences in rates of refusal.

TABLE 3 ABOUT HERE

In trying to understand this difference, one might point to any of various differences between the WLS and NLSY, such as the ages and birth years of sample members, the geographic area represented, the number and frequency of interviews, or the interview mode. I chose to focus first on methods of refusal conversion. The 1992 WLS attempted to convert refusals just by having especially skilled interviewers place a second call. The 2004 WLS engaged in a much more extensive effort to convert refusals, including sending a packet that included the 1992 respondent report and a CD of popular songs from 1957 before attempting conversion (and sometimes attempting more than once). Even so, conversion rates for respondent refusals in 2004 was only 19.4%, and there was no relationship between conversion and cognitive skills ($p = .32$ in the direction of those with higher cognitive skills being *more* likely to be converted).

NLSY79 refusal conversation efforts in 1998, meanwhile, included a discretionary and variable increase in the financial incentive to participate (Olsen 2005; precise amounts used in such conversions are not publicly available). Designations of cases as converted or as refusals indicate that 72.6% of initial refusals in 1998 were successfully converted. NLSY79 refusal conversion was not only successful but was differentially successful: respondents with lower cognitive skills who initially refused were more likely to participate following the refusal conversion effort than were those with higher ability. This can be seen by looking at the initial (i.e., pre-conversion) refusal rates in the NLSY79 in Table 3. While 34.7% of respondents in the lowest quintiles initially refused, only 23.8% of those in the highest quintile did (indicating a difference of 85% vs. 60% in refusal conversion rates). As with the earlier models of ultimate refusal, the effect of adolescent cognitive ability was not at all attenuated in a logistic regression model by the addition of controls for parents' prior or respondents' subsequent education.

Evidence of serial conversion in NLSY79 raises the possibility that some respondents might initially refuse to participate with the expectation they can hold out and receive more money. Specifically, the percentage of converted respondents in one wave who initially refused in the next wave increased from about 20% in the 1981 NLSY79 to over 70% by the 1998 NLSY. This serial conversion does not undermine the basic result, as presumably, without the added incentive, most initial refusals would have ended up ultimate refusals sooner or later. Thus, it seems that the use of significant financial incentives in NLSY79 might plausibly be credited with preventing the cognitive gradient in refusal rates observed in the WLS.²

² Given the lack of available data on whether particular respondents were converted by persuasion or by offering incentives, these results cannot speak to the Lengacher et al. (1995) finding that respondents offered a large incentive in the inaugural wave of the Health and Retirement Study (HRS) were not more likely to refuse to participate in the second round than reluctant respondents converted by persuasion alone. Regardless, respondents in later waves of

We can adduce further evidence for this possibility by expanding the analysis to include all NLSY79 reinterviews from 1980 to 2004 (Table 4). As it happens, after 1998, NLSY79 switched to fielding strategies in which the use of differential incentives in refusal conversion was decreased. In 2000, an experiment involving increased initial incentives for all remaining respondents (\$40 or \$80) was conducted after an across-the-board \$20 incentive appeared to yield higher ultimate refusal rates (Olsen 2005). In 2002 onward, respondents are offered the opportunity for a higher incentive by contacting NORC upon receipt of the advance mailing instead of waiting to be contacted (a difference of \$80 vs. \$40), and resistant respondents are told that they can receive a higher incentive in the next round by participating in this “early bird” program next time. NLSY79 respondents thus experienced an increase in the initial incentive offered either in 2000 or 2002 (or both). As Table 4 indicates, initial refusals for those in the lowest quintile decreased dramatically from 1998 onward, eliminating (at least for the time being) the inverse cognitive gradient in initial refusals. While all this is only indirect evidence that incentives per se explain observed differences between the WLS and NLSY79, the sharp difference in NLSY79 results before and after 2000 would suggest the difference cannot be attributed to any stable advantage in the persuasion skills of NORC interviewers versus WLS interviewers with lower ability populations.

TABLE 4 ABOUT HERE

This could be examined more directly with specific information on the differential incentives offered in different rounds in the NLSY79. Moreover, data from the 2000 incentives experiment, especially compared to the respondents not included in the experiment, could be

NLSY79 probably had much stronger grounds for inferring that refusals would be followed by an increased incentive than did HRS respondents, if the first and second waves of a longitudinal study are experienced as much more distinct than the tenth and eleventh waves.

used to see where cognitive skills moderated effects of the presence or size of an increased financial incentive. For that matter, acceptances of the 2004 Early Bird offer could be used to see if this option is relatively attractive to lower ability respondents who had been subject to serial conversion efforts before. None of these data are presently available in the NLSY79 public release and thus could not be examined in this study. Researchers with access to this information in NLSY79 or comparable information in other longitudinal data with good measures of respondent cognition, however, are urged to consider how cognition is related to differential response to incentives and its implications for overall response rates.

In considering the reasons for a cognitive gradient in refusals in the absence of significant financial incentives, one might again consider surveys more burdensome for those with more limited verbal ability. Unlike the HN test for the WLS, which provides only a general score, the ASVAB contains subscales that allow for comparative evaluation of verbal and quantitative skills on the probability of initial refusal. Surprisingly, for a model including verbal and quantitative skills along with gender and cohort indicates that the significant relationship between cognition and initial refusal in the 1998 NLSY79 is entirely explained by *quantitative* ability, with verbal ability having no significant effect net of quantitative ability (marginal effects of standard deviation increase in ability on probability of refusal being $-.059$ for quantitative ability [$p < .001$] and $+.004$ [$p = .652$] for verbal ability). This result is inconsistent with any explanation of the relationship between cognitive skills and survey participation that focuses on linguistic burden. Because the NLSY79 asks many economic questions—as well as questions about the dates of events—it could be said to contain more quantitative content than many other surveys, which could lead to quantitative ability figuring more importantly in response rates for the NLSY79 than elsewhere.

DISCUSSION

Survey methodologists have long recognized that people participate in surveys for different reasons. A possibility suggested by our results is that nonfinancial appeals may be more effective among respondents with higher cognitive skills. Cognitive factors are already thought to be important for explaining the relationship between education and civic-minded activities like voting (Luskin 1990; Nie, Junn, and Stehlik-Barry 1996), political participation (Neuman 1986) or volunteering (Wilson 2000). Why this is so remains largely unexplained: cognitive advantages may lead to life advantages beyond those accounted for in standard socioeconomic measures and thereby provide even stronger incentives to endorse civic virtues, or the same tendencies involved in later civic-mindedness might encourage more motivated behavior in school or specifically on test tests. In any case, given the known association between cognitive skills and prosocial and civic behavior, we might expect cognitive skills to be positively associated with response to prosocial-spirited appeals.

The result might be confined to longitudinal studies. Important to recognize is that the WLS and NLSY79 both have very high response rates relative to less elaborately fielded cross-sectional studies, indicating that some participants in these studies can be expected to refuse other kinds of survey participation requests. Appeals about the special character of the longitudinal studies—how such data is uniquely important or how individual respondents “cannot be replaced” by anyone else—might be more readily appreciated and thus more effective among respondents with higher cognitive skills. Of course, specific conjectures about appeals are most readily resolved by experiment. That said, the content of the survey on which such an experiment was conducted might also be important: surveys with a strong focus on life

outcomes, especially if they began recruiting when respondents were in school, could be differentially appealing to respondents who did well in school.

Although not intended (at least originally) as a study of incentives, the results suggest that incentives may mitigate any tendency for those with lower cognitive skills to be more likely to refuse to participate in surveys. This finding would be consistent with others that incentives may be disproportionately effective among those with lower education or lower income and, if these groups are otherwise more likely to refuse to participate, can thus improve the representativeness of surveys (see Singer et al. 1999; Singer, Van Hoewyk, and Maher 2000). Indeed, this study suggests that cognitive skills may be vital to understanding the psychological factors that underlie these earlier results about the differential effect of incentives by education and income. In any case, the example of WLS suggests that even surveys that have successfully attained high response rates without incentives might consider employing them to reduce possible biases due to nonresponse.³ Further work with panel studies containing cognitive skills data is needed to determine whether the patterns observed here are more general and, if so, how the form and magnitude of incentives affect ultimate cognitive gradients in participation.

³ The WLS cannot implement differential incentives in the refusal conversion process as simply as the NLSY, as many WLS respondents are in contact with one another (but see Singer, Groves, and Corning 1999 on respondent attitudes toward information about differential incentives).

REFERENCES

- Anand, Sowmya Narayan and Jon A. Krosnick. 2004. "Satisficing When Answering Questions Measuring Attitudes: The Impact of Cognitive Skills." Unpublished manuscript, Stanford University.
- CHRR (Center for Human Resource Research). 2004. *NLSY79 User's Guide*. Available online at <http://www.bls.gov/nls/79guide/2002/nls79gC.pdf>.
- Fischer, Claude S., Michael Hout, Martín Sánchez Jankowski, Samuel R. Lucas, Ann Swidler, and Kim Voss. 1996. *Inequality By Design: Cracking the Bell Curve Myth*. Princeton, NJ: Princeton University Press.
- Groves, Robert M. and Mick P. Couper. 1998. *Nonresponse in Household Interview Surveys*. New York: John Wiley and Sons.
- Hauser, Robert M. 2005. "Survey Response in the Long Run: The Wisconsin Longitudinal Study." *Field Methods* 17:3-29.
- Krosnick, Jon A. 1991. "Response strategies for coping with the cognitive demands of attitude measures in surveys." *Applied Cognitive Psychology* 5:213-236.
- Krosnick, Jon A. 2002. "The Causes of No-Opinion Responses to Attitude Measures in Surveys: They Are Rarely What They Appear To Be." in *Survey Nonresponse*, edited by R. M. Groves, D. A. Dillman, J. L. Eltinge, and R. J. A. Little. New York: Wiley.
- Lengacher, Jennie E., Colleen M. Sullivan, Mick P. Couper, and Robert M. Groves. 1995. "Once Reluctant, Always Reluctant? Effects of Differential Incentives on Later Survey Participation in a Longitudinal Study." *Proceedings of Survey Research Methods Section of the American Statistical Association*, 1029-1034.

- Luskin, Robert C. 1990. "Explaining Political Sophistication." *Political Behavior* 4:331-361.
- Neuman, W. Russell. 1986. *The Paradox of Mass Politics: Knowledge and Opinion in the American Electorate*. Cambridge, MA: Harvard University Press.
- Nie, Norman H., Jane Junn, and Kenneth Stehlik-Barry. 1996. *Education and Democratic Citizenship in America*. Chicago, IL: University of Chicago Press.
- NLSY (National Longitudinal Study of Youth). n.d. "Attachment 106: Profiles of American Youth." Available from http://www.nlsinfo.org/ordering/display_db.php3.
- Olsen, Randall J. 2005. "The problem of respondent attrition: survey methodology is key." *Monthly Labor Review* 128:63-70.
- Schaie, K. Warner. 1996. *Intellectual Development in Adulthood: The Seattle Longitudinal Study*. New York: Cambridge University Press.
- Singer, Eleanor, Robert M. Groves, and Amy D. Corning. 1999. "Differential Incentives: Beliefs About Practices, Perceptions of Equity, and Effects on Survey Participation." *Public Opinion Quarterly* 63:251-60.
- Singer, Eleanor, John Van Hoewyk and Mary P. Maher. 2000. "Experiments with Incentives in Telephone Surveys." *Public Opinion Quarterly* 64: 171-188.
- Singer, Eleanor, John Van Hoewyk, Nancy Gebler, Trivellore Ranghunathan, and Katherine McGonagle. 1999. "The Effect of Incentives on Response Rates in Interviewer-Mediated Surveys." *Journal of Official Statistics* 15:217-230.
- Wilson, John. 2000. "Volunteering." *Annual Review of Sociology* 26:215-240.
- Wisconsin Longitudinal Study. 2006. Robert M. Hauser and Taissa S. Hauser, principal investigators. Documentation available at: <http://www.ssc.wisc.edu/~wls/documentation>

Table 1. Dimensions of the Five-Factor Model of Personality and Their Measurement in the Wisconsin Longitudinal Study (1993 wave)

Dimension	Items
Openness	prefers work that is routine and simple*; inventive; prefers the conventional, traditional*; values artistic, aesthetic experiences; has an active imagination; wants things to be simple and clear-cut*; sophisticated in art, music, and literature
Neuroticism	worries a lot; relaxed and handles stress well*; can be tense; emotionally stable, not easily upset*; remains calm in tense situations*; gets nervous easily
Agreeableness	tends to find fault with others*; has a forgiving nature; sometimes rude to others*; generally trusting; can be cold and aloof*; considerate to almost everyone; likes to cooperate with others
Conscientiousness	easily distracted*; can be somewhat careless*; does a thorough job; a reliable worker; tends to be disorganized*; lazy at times*; does things efficiently
Extraversion	tends to be quiet*; outgoing and sociable; talkative; reserved*; full of energy; shy or inhibited*; generates a lot of enthusiasm

Asterisks denote items to be reverse scored for scaling. All items use stem "I see myself as a person who (is)" and have six response categories ranging from "agree strongly" to "disagree strongly." First item in list was administered on both phone and mail survey, second item administered on phone only, the rest were administered on mail only. Summated scales standardized for all analyses. Lower-bound reliability estimates (Cronbach's α): Openness = .69, Neuroticism = .83, Agreeableness = .74, Conscientiousness = .70, Extraversion = .82. The greater homogeneity of the WLS sample implies lower reliabilities than would be expected for nationally representative samples.

Table 2. Estimated Effects of Psychological and Sociodemographic Characteristics on Internet Adoption

	Model 1	Model 2	Model 3	Model 4
HN score	0.529*** (0.030)		0.294*** (0.033)	0.277*** (0.038)
Openness	0.383*** (0.031)		0.265*** (0.033)	0.249*** (0.039)
Neuroticism	-0.100*** (0.029)		-0.103*** (0.031)	-0.110** (0.036)
Agreeableness	-0.068* (0.029)		-0.067* (0.031)	-0.060 (0.035)
Conscientiousness	-0.063* (0.028)		-0.076* (0.030)	-0.102** (0.035)
Extraversion	0.009 (0.028)		-0.048 (0.030)	-0.067 (0.034)
Female	-0.041 (0.055)	0.237** (0.083)	0.236** (0.085)	0.211* (0.099)
No spouse		-0.406*** (0.089)	-0.442*** (0.090)	-0.437*** (0.108)
Some college		0.489*** (0.077)	0.321*** (0.079)	0.323*** (0.092)
College degree		0.685*** (0.084)	0.375*** (0.088)	0.385*** (0.103)
Household income		0.107* (0.045)	0.083 (0.045)	0.080 (0.050)
Net worth		0.092*** (0.027)	0.088** (0.028)	0.079* (0.031)
Occupational education		0.466*** (0.059)	0.394*** (0.060)	0.259*** (0.070)
Occupational income		0.036 (0.072)	-0.023 (0.074)	0.052 (0.087)
Rural residence		-0.382*** (0.060)	-0.349*** (0.061)	-0.242*** (0.071)
Online child		0.545*** (0.104)	0.497*** (0.106)	0.507*** (0.123)
Spouse age		-0.001* (0.001)	-0.001* (0.001)	-0.001 (0.001)
Spouse no hs diploma		-0.055 (0.110)	-0.037 (0.113)	-0.053 (0.134)
Spouse some college		0.254** (0.093)	0.241* (0.094)	0.220* (0.109)
Spouse college		0.128 (0.095)	0.095 (0.097)	0.085 (0.111)
Spouse occupational education		0.221*** (0.060)	0.179** (0.061)	0.144* (0.070)
Spouse occupational income		-0.036 (0.074)	-0.006 (0.076)	0.053 (0.089)
Currently working				-0.288*** (0.066)
Uses net at work				1.071*** (0.076)
N	6849	6849	6849	5281
bic	8604.428	8315.810	8156.083	6107.782

* $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed). Standard errors in parentheses. Models also include terms for missing values on occupation, spouse occupation, or spouse education.

Table 3. Logistic regression estimates of the effect of psychological characteristics on Internet adoption, by sex

	WLS Females		WLS Males	
	Model 1	Model 2	Model 1	Model 2
HN score	0.471*** (0.049)	0.295*** (0.053)	0.595*** (0.048)	0.262*** (0.055)
Openness	0.367*** (0.049)	0.241*** (0.053)	0.443*** (0.054)	0.281*** (0.059)
Neuroticism	-0.104* (0.046)	-0.091 (0.048)	-0.133** (0.050)	-0.146** (0.053)
Agreeableness	-0.067 (0.049)	-0.060 (0.050)	-0.103* (0.047)	-0.082 (0.050)
Conscientiousness	-0.084 (0.045)	-0.118* (0.048)	-0.073 (0.047)	-0.088 (0.050)
Extraversion	0.008 (0.044)	-0.010 (0.045)	-0.010 (0.047)	-0.060 (0.050)
N	3687	3687	3161	3161
BIC	4754.020	4631.907	3886.901	3653.655

* $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed). Standard errors in parentheses. Model 2 includes all regressors (except sex) from Model 3 in Table 2.

Table 4. Logistic regression estimates of effect of educational attainment on log odds of home internet adoption

WLS females (N = 3687)

	some college	college graduates
bivariate	.652*** (0%)	1.163*** (0%)
adding HN score	.496*** (24%)	.770*** (34%)
adding personality variables	.363*** (44%)	.545*** (53%)
adding income and wealth	.297*** (54%)	.446*** (62%)
adding occupational measures	.196* (70%)	.158* (86%)
adding spousal characteristics	.148* (77%)	.053 (95%)

WLS males (N = 3161)

	some college	college graduates
bivariate	1.086*** (0%)	1.810*** (0%)
adding HN score	.914*** (16%)	1.413*** (22%)
adding personality variables	.819*** (25%)	1.302*** (28%)
adding income and wealth	.738*** (32%)	1.133*** (37%)
adding occupational measures	.611*** (44%)	.770*** (57%)
adding spousal characteristics	.575*** (47%)	.683*** (62%)

* $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed). Percentage attenuation from bivariate regression in parentheses. Respondents with high school diploma only are reference category for estimates.

Table 5. Logistic regression coefficients of psychological and sociodemographic characteristics on whether respondent used Internet at current/last job

	High school only		Some college		College degree	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
HN score	0.433***§ (0.048)	0.306***§ (0.052)	0.302*** (0.090)	0.225* (0.095)	0.248** (0.079)	0.124 (0.086)
Openness	0.330*** (0.049)	0.258*** (0.052)	0.350*** (0.094)	0.302** (0.098)	0.287*** (0.082)	0.274** (0.087)
Neuroticism	-0.086 (0.044)	-0.085 (0.047)	-0.086 (0.087)	-0.070 (0.092)	-0.250** (0.077)	-0.204* (0.083)
Agreeableness	-0.000 (0.045)	-0.005 (0.048)	-0.106 (0.085)	-0.126 (0.088)	-0.121 (0.072)	-0.113 (0.077)
Conscientiousness	-0.022 (0.044)	-0.064 (0.047)	-0.179* (0.082)	-0.214* (0.087)	-0.032 (0.069)	-0.090 (0.075)
Extraversion	-0.020 (0.043)	-0.067 (0.046)	-0.031 (0.079)	-0.082 (0.084)	0.056 (0.066)	-0.058 (0.074)
Female	0.233** (0.085)	0.278 (0.142)	-0.058 (0.160)	0.242 (0.250)	-0.373** (0.136)	0.045 (0.188)
N	2777	2777	818	818	1439	1439
BIC	3680.433	3524.548	1066.457	1106.388	1506.493	1464.691

* $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed). §Indicates $p < .05$ for interactions across categories. Standard errors in parentheses. Model 2 includes all controls from Model 4 in Table 2.

Table 6. Logistic Regression Estimates of the Effects of Basic Psychological Characteristics and Gender on Home Internet Adoption, by Wealth

	Below median wealth		Above median wealth	
	Model 1	Model 2	Model 1	Model 2
HN score	0.406*** [§] (0.058)	0.335*** (0.060)	0.250*** [§] (0.061)	0.193** (0.063)
Openness	0.260*** (0.053)	0.265*** (0.056)	0.279*** (0.057)	0.258*** (0.059)
Neuroticism	-0.093 (0.051)	-0.098 (0.052)	-0.114* (0.054)	-0.117* (0.055)
Agreeableness	-0.032 (0.051)	-0.042 (0.052)	-0.055 (0.053)	-0.074 (0.054)
Conscientiousness	0.003 [§] (0.050)	-0.006 [§] (0.051)	-0.180*** [§] (0.053)	-0.193*** [§] (0.054)
Extraversion	-0.036 (0.049)	-0.094 (0.052)	0.004 (0.053)	-0.045 (0.055)
Female	0.101 (0.098)	0.296* (0.144)	0.046 (0.104)	0.146 (0.151)
N	2497	2497	2537	2537
BIC	3108.347	3082.386	2887.639	2925.896

* $p < .05$, ** $p < .01$, *** $p < .005$ (one-tailed). [§]Indicates $p < .05$ for interactions across categories. Standard errors in parentheses. Model 1 includes education, job status, and internet at work as additional controls. Model 2 includes all controls from Model 4 in Table 2.

Table 7. Logistic regression coefficients of psychological and sociodemographic characteristics on whether respondent used Internet at current or last job

	WLS Females			WLS Males		
	Model 1 (full sample)	Model 2 (full sample)	Model 2 (current workers)	Model 1 (full sample)	Model 2 (full sample)	Model 2 (current workers)
HN score	0.287*** [§] (0.047)	0.154** (0.052)	0.211** (0.076)	0.553*** (0.049)	0.240*** (0.056)	0.179* (0.079)
Openness	0.278*** [§] (0.050)	0.187*** (0.055)	0.218** (0.077)	0.453*** (0.057)	0.329*** (0.060)	0.359*** (0.080)
Neuroticism	-0.132** (0.048)	-0.107* (0.049)	-0.046 (0.073)	-0.082 (0.052)	-0.079 (0.055)	-0.088 (0.077)
Agreeableness	-0.043 (0.048)	-0.012 (0.050)	0.066 (0.071)	0.048 (0.047)	0.085 (0.050)	0.010 (0.070)
Conscientiousness	0.143** (0.046)	0.114* (0.049)	0.217** (0.071)	0.035 (0.048)	0.019 (0.050)	0.105 (0.070)
Extraversion	0.035 (0.045)	0.040 (0.047)	-0.023 (0.068)	0.055 (0.047)	0.036 (0.049)	-0.004 (0.069)
No spouse		0.231* (0.097)	0.047 (0.136)		-0.289* (0.142)	-0.270 (0.208)
Some college		0.154 [§] (0.122)	0.174 [§] (0.175)		0.792*** (0.131)	0.968*** (0.184)
College degree		0.158 [§] (0.118)	0.265 [§] (0.170)		1.132*** (0.119)	1.198*** (0.168)
Rural residence		-0.330*** [§] (0.103)	-0.460** (0.145)		-0.482*** (0.111)	-0.501** (0.155)
N	2820	2820	1156	2464	2464	1222
BIC	3363.605	3208.590	1529.779	3013.352	2841.271	1477.085

* $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed). [§]Indicates $p < .05$ for difference between females and males. Standard errors in parentheses.

Table 8. Logistic Regression Estimates of the Effects of Basic Psychological Characteristics and Gender on Home Internet Adoption, by Whether Internet is Used at Work

	Currently working		Not currently working	
	Uses Internet at work	No Internet at work	Used Internet at last job	No Internet at last job
HN score	0.080 [§] (0.100)	0.395*** [§] (0.073)	0.220 (0.114)	0.299*** (0.059)
Openness	0.113 (0.106)	0.382*** (0.075)	0.400** (0.131)	0.174** (0.058)
Neuroticism	-0.229* (0.095)	-0.082 (0.069)	-0.050 (0.115)	-0.126* (0.053)
Agreeableness	-0.214* [§] (0.093)	-0.045 [§] (0.066)	-0.076 (0.115)	-0.011 (0.055)
Conscientiousness	-0.226* (0.093)	0.018 (0.067)	-0.142 (0.118)	-0.129* (0.052)
Extraversion	0.015 (0.084)	-0.144* (0.068)	-0.242* (0.109)	-0.022 (0.052)
N	1026	1351	775	2129
BIC	1128.104	1771.990	816.935	2776.005

* $p < .05$, ** $p < .01$, *** $p < .001$ (two-tailed). [§]Indicates $p < .05$ for interactions across categories. Standard errors in parentheses. Model 1 includes education, job status, and internet at work as additional controls. Model 2 includes all controls from Model 4 in Table 2.

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