



# Respondent Incentives in a Multi-Mode Panel Survey: Cumulative Effects on Nonresponse and Bias

Annette Jäckle and Peter Lynn<sup>1</sup>

ISER Working Paper  
2007-01

<sup>1</sup>The views expressed are those of the authors and not necessarily those of the Department for Education and Skills.

## Acknowledgement:

We would like to thank Iain Noble at the Department for Education and Skills for facilitating the data and commenting on an earlier version of the paper, Tim Thair and Rory Fitzgerald for patient and helpful response to data queries, Noah Uhrig, Heather Laurie for comments and Mark Bryan for advice on the calculation of interactions in nonlinear models.

Readers wishing to cite this document are asked to use the following form of words:

Jäckle, Annette and Lynn, Peter (January 2007) 'Respondent Incentives in a Multi-Mode Panel Survey: Cumulative Effects on Nonresponse and Bias', ISER Working Paper 2007-01.  
Colchester: University of Essex.

The on-line version of this working paper can be found at <http://www.iser.essex.ac.uk/pubs/workpaps/>

The Institute for Social and Economic Research (ISER) specialises in the production and analysis of longitudinal data. ISER incorporates

- MISOC (the ESRC Research Centre on Micro-social Change), an international centre for research into the lifecourse, and
- ULSC (the ESRC UK Longitudinal Studies Centre), a national resource centre to promote longitudinal surveys and longitudinal research.

The support of both the Economic and Social Research Council (ESRC) and the University of Essex is gratefully acknowledged. The work reported in this paper is part of the scientific programme of the Institute for Social and Economic Research.

Institute for Social and Economic Research, University of Essex, Wivenhoe Park,  
Colchester. Essex CO4 3SQ UK  
Telephone: +44 (0) 1206 872957 Fax: +44 (0) 1206 873151 E-mail: [iser@essex.ac.uk](mailto:iser@essex.ac.uk)  
Website: <http://www.iser.essex.ac.uk>

© January 2007

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form, or by any means, mechanical, photocopying, recording or otherwise, without the prior permission of the Communications Manager, Institute for Social and Economic Research.

## ABSTRACT

Respondent incentives are increasingly used as a measure of combating falling response rates and resulting risks of nonresponse bias. Nonresponse in panel surveys is particularly problematic, since even low wave-on-wave nonresponse rates can lead to substantial cumulative losses, and if nonresponse is differential, may lead to increasing bias across waves. Although the effects of incentives have been studied extensively in cross-sectional contexts, little is known about cumulative effects across waves of a panel. We provide new evidence about the effects of continued incentive payments on attrition, bias and item nonresponse, using data from a large scale, multi wave, mixed mode incentive experiment on a UK government panel survey of young people. In this study, incentives significantly reduced attrition, far outweighing negative effects on item nonresponse in terms of the amount of information collected by the survey per issued case. Incentives had proportionate effects across a range of respondent characteristics and as a result did not reduce attrition bias. The effects of incentives were larger for unconditional than conditional incentives and larger in postal than telephone mode. Across waves, the effects on attrition decreased somewhat, although the effects on item nonresponse and the lack of effect on bias remained constant. The effects of incentives at later waves appeared to be independent of incentive treatments and mode of data collection at earlier waves.

*Keywords:* attrition, item nonresponse, mail survey, CATI, unconditional incentive, conditional incentive

## 1 Introduction

Surveys around the world are facing declining response rates, and with this, increasing risks of nonresponse bias if nonrespondents systematically differ from respondents. For panel surveys this is particularly problematic, since even low nonresponse rates at each wave can lead to large cumulative losses. If nonresponse is differential, bias could increase with the duration of the panel. In order to boost participation, survey organisations increasingly offer respondent incentives. This paper provides new evidence on the cumulative effects of incentives on attrition, attrition bias and item nonresponse, using data from a large scale, multi wave, mixed mode incentive experiment on a UK government panel survey of young people.

The effects of incentives have been studied in many settings: monetary incentives increase response more than gifts or lotteries (Church 1993; Singer et al. 1999); unconditional incentives (given at the time of the survey request) increase response more than conditional incentives (promised in return for participation) (Church 1993; Goyder 1994; Hopkins and Gullickson 1992; Singer et al. 1999); response increases with the value of the incentive (Armstrong 1975; Church 1993; Fox, Crask, and Kim 1988; Hopkins and Gullickson 1992; Rodgers 2002; Yu and Cooper 1983); incentives have larger effects in studies with low response rates and larger effects in postal than interviewer administered surveys (Singer et al. 1999). Most evidence of the effect of incentives in different modes, however, stems from comparisons of separate studies and fails to control for differences in other measures affecting response. As a result, differences in the effects of incentives are not necessarily genuine mode effects. The study by Ryu, Couper and Marans (2006) is an exception. The authors compared the effects of monetary incentives and gifts in a mixed mode postal and face-to-face survey. Their study did not, however, include a no-incentive condition and so did not allow an evaluation of the magnitude of incentive effects across modes. We compared the effects of incentives in a mixed postal and computer assisted telephone interviewing (CATI) survey and, in postal mode, also examined the effects of conditional and unconditional incentives.

Research on the effects of incentives has focused on response rates and little is known about the effects on bias, the ultimate reason for concern about low response. Incentive studies are mostly limited to studying effects on bias in sample composition and some studies have found that incentives do disproportionately increase participation of respondents typically under-represented, for example, those with low education (Singer, Van Hoewyk,

and Maher 2000), poor (James 1997), black or poor (Mack et al. 1998), of black or Indian minority ethnic groups, living in larger households or households with dependent children, aged 0-20, or single (Stratford, Simmonds, and Nicolaas 2003). Biases in sample composition are however not necessarily correlated with biases in important survey estimates, especially since typically only a handful of compositional characteristics are studied. Ultimately, studies of nonresponse bias are limited by the lack of information about nonrespondents, a limitation, which can be overcome to some extent by panel studies, where information about nonrespondents is available from waves prior to the dropout. We estimated the extent of bias due to attrition in terms of sample composition and survey variables and the effectiveness of incentives at reducing bias, exploiting the information on attriters available from the panel.

Additionally, little is known about the effects of incentives over waves of a panel survey. In a review of the use of incentives in longitudinal studies, Laurie and Lynn (forthcoming) concluded that, given the cost implications of changing incentive conditions, there was surprisingly little evidence about the longer term effects of such changes to guide survey practitioners. Quoting an internal memorandum of the US Census Bureau, Ward et al. wrote that a “review of the well-known longitudinal studies (Downs 1999) found that all non-Census Bureau studies used a monetary incentive during each wave, but there had been no scientific tests to determine the effectiveness of the incentives” (Ward et al. 2001:2). If attrition leads to drop-out of the least co-operative, the sample might increasingly be composed of committed respondents who are less responsive to incentives, because they are sufficiently motivated to participate even without the incentive (Laurie and Lynn forthcoming). In this case, incentives may have decreasing marginal effects on response rates over the life of the panel. By the same token, incentives may have increasing effects on attrition bias, if they have disproportionate effect on sample members who would otherwise be more likely to drop out. Although some incentive studies have been carried out in the context of panels, they mostly only covered one wave, or examined the effect of changes in incentive treatment from one wave to the next. Martin, Abreu and Winters (2001) and Ward et al. (2001), for example, studied the effects of incentives on conversion rates of previous wave nonrespondents; Rodgers (2002) and Laurie (2006) examined the effects of changes in incentive values in a panel. The only studies which examined cumulative effects of incentives over more than two waves appear to be those by James (1997), Mack et al. (1998) and Laurie and Lynn (forthcoming), who reported that the positive effect of an incentive paid early in a panel persisted for several waves even without repeated incentive payment. These studies, however, only examined the effect of an incentive paid in a single wave and did not examine

the cumulative effects of incentives offered over successive waves. We examined the cumulative effects of continued incentive payments across three waves spanning a time frame of three years, as well as the effects of changes from telephone to postal mode and from conditional to unconditional incentive treatment.

Finally, there is conflicting evidence about the effects of incentives on data quality. Although concern is frequently voiced that incentives may lead to lower data quality, by marginally motivating respondents who would otherwise have dropped out of the study but are not sufficiently motivated to respond diligently, existing studies have either found that incentives lead to improved respondent effort and less item nonresponse (James and Bolstein 1990; Mack et al. 1998; Singer et al. 2000), or have found no relationship (Berk et al. 1987; Davern et al. 2003; Goyder 1994; Shettle and Mooney 1999; Singer et al. 1999; Teisl, Roe, and Vayda 2005; Tzamourani and Lynn 1999; Willimack et al. 1995). Item nonresponse is potentially critical, because analysts typically only use cases with complete data. This leads to losses in efficiency due to reductions in sample sizes, and similar to unit nonresponse, can lead to biased estimates and invalid inference if item nonrespondents are not a random subset of the sample (Mason, Lesser, and Traugott 2002). Problems of item nonresponse increase for multivariate analysis, if the patterns of missingness vary across items, and for analysis of change, which in addition depends on complete information at different points in time. Since incentives may affect both unit and item nonresponse, it is then not clear what their net effect may be on repeated measures derived from a panel study. We examined the effect of incentives on item nonresponse rates and calculated their net effect on attrition and item response.

## **2 Hypotheses tested**

The outcomes measured for this analysis were the attrition rate, item NR rate and attrition bias. Attrition was an absorbing state, since the survey did not re-issue nonrespondents at later waves. Item NR was measured as the number of non-branched items missing, either due to refusals or ‘don’t know’ answers. Attrition bias was measured in terms of socio-demographic characteristics and wave 1 survey measures. These three measures were used to test the following:

H1: Effects of incentives on attrition, item NR and attrition bias.

In previous studies incentives have generally increased response rates, be it because norms of social exchange oblige the respondent to return a “favour” (norm of reciprocity, Gouldner 1960) or because the incentive substitutes for a lack of motivation to

participate for other reasons, such as civic duty or topic interest (leverage-salience theory, Groves, Singer, and Corning 2000). Incentives may in addition motivate respondents to provide better quality responses, reducing item NR. At the same time incentives may change the sample composition to include more respondents who are not diligent about answering the survey questions, and as a result increase item NR. Finally, incentives may have differential effects on attrition across sample members. Those with a high propensity to participate in the survey without the incentive may be less susceptible to incentives, while those more likely to drop out of the survey may be more susceptible. As a result, incentives may reduce attrition bias.

*Null hypothesis H1: Incentives have no effect on attrition, item NR or attrition bias.*

H2: Effects of incentives across waves.

Incentives may have decreasing effect on unit response across waves, if attrition leads to dropout of the least motivated sample members and the remaining members are sufficiently motivated to participate for other reasons and hence less susceptible to incentives (Laurie and Lynn forthcoming). At the same time, incentives may have increasing effect on attrition bias, if bias increases across waves and incentives disproportionately retain those in the sample who are most likely to drop out.

*Null hypothesis H2: The effects of incentives do not change across waves.*

H3: Effects of unconditional and conditional incentives in a panel context.

Previous studies, on cross-sectional surveys, suggest that unconditional incentives have larger effects on unit NR, possibly because the pre-payment signals that the survey organisation trusts the sample member will participate, reinforcing the norm of reciprocity. Whether the different incentive conditions have different effects on item NR is not clear.

*Null hypothesis H3: Unconditional and conditional incentives have comparable effects in a panel context.*

H4: Effects of incentives in postal and telephone mode.

Comparisons of previous studies suggest that incentives have a larger effect in postal mode, possibly because in telephone mode the interviewer already functions as an external motivator to increase both unit and item response (Singer et al. 1999) and the scope for additional improvements is smaller.

*Null hypothesis H4: Incentives have comparable effects in postal and telephone mode.*

H5: Effects of changes over waves in mode or incentive treatment.

Compared to sample members allocated to the same mode and treatment across waves, those who were allocated to different treatments or different modes may differ in their experiences of previous survey waves and their expectations about future waves. As a result, the effect of incentives may not only be conditional on the treatment and mode at the current wave, but may be influenced by the treatment in previous waves.

*Null hypothesis H5: Changes in mode or incentive treatment over waves do not have lasting effects.*

H6: Effects of incentives across ability levels.

Sample members with low education levels are typically more likely to drop out of surveys. If incentives reduce attrition bias, they should therefore disproportionately reduce attrition among lower achievers. Low ability respondents may at the same time be more likely to provide incomplete responses, if they find the task of completing the postal questionnaire more difficult. This may increase item NR disproportionately among this group.

*Null hypothesis H6: Incentives have comparable effects across ability levels.*

### **3 Study Design**

The Youth Cohort Study of England and Wales (YCS) investigates transitions from compulsory education to further or higher education or the labour market and typically samples cohorts of 16 to 17 year-olds every two years, who are surveyed on several occasions at annual intervals. The incentives experiment was embedded in waves 2, 3 and 4 of cohort 10. The survey is managed and funded by the Department for Education and Skills, who jointly designed the incentive experiment with the National Centre for Social Research, the survey contractors for waves 2 and 3 of YCS Cohort 10.

#### **3.1 The Survey**

The population studied in the YCS cohort 10 consisted of pupils in England and Wales who had reached minimum school leaving age of 16 in the 1998/1999 school year (Russell and Phelps 2001), that is, a one year age cohort of pupils born between 1-9-1982 and 31-8-1983. A 10% random sample was drawn from the registers of schools (excluding special schools and schools with fewer than 20 pupils of that age) in 1999, by asking schools to provide the names and addresses of pupils born on the 5th, 15th and 25th of every month. From the resulting file of 31,424 names and addresses a systematic random sample of 25,000 pupils was drawn. The first wave of the survey took place a year later in spring 2000, the second at

the end of 2000, the third in spring 2002 and the fourth in spring 2003. Nonrespondents were not issued in subsequent waves and as a result, attrition was monotonic.

Wave 1 was a postal survey with telephone follow-up of nonrespondents after 4 mailings (initial questionnaire mailing and three reminders). Based on reported examination results, wave 1 respondents were classified as either ‘higher achievers’ (if they had obtained 5 GCSEs at grades A\* to C<sup>1</sup>) or ‘lower achievers’ otherwise. At wave 2 roughly one third of issued sample members were randomly selected for additional questions on particular topics and assigned to computer assisted telephone interviewing (CATI). In addition to the core questionnaire, telephone respondents were administered a module on decisions about entering higher education (for higher achievers) or on educational and employment aspirations (for lower achievers). The remaining sample members were administered the core questionnaires by post. At wave 3 all lower achievers received the core mail questionnaire, although the telephone module was still carried for higher achievers. At wave 4 all respondents were assigned to the core postal survey. Figure 1 illustrates the allocation to modes and incentives.

< Figure 1 >

The core questionnaire was shorter at wave 2 than wave 1, but remained mainly unchanged for the three experimental waves. Telephone respondents were asked the core questions before the additional modules. The core questionnaire was the same as the postal questionnaire, although some items were adapted for administration over the telephone.<sup>2</sup> The average telephone interview took around 20 minutes.

### **3.2 The Incentives Experiment**

Facing growing concerns over declining response rates, an experiment was introduced in the second wave of cohort 10, to study the effect of incentive payments on response rates and nonresponse bias. A proportion of wave 1 respondents on both the postal and telephone

---

<sup>1</sup> The General Certificate of Secondary Education (GCSE) is by far the most common type of qualification gained by pupils aged 14-16 in England and Wales. GCSEs can be taken in a wide variety of subjects. Grades awarded are A\*, A, B, C, D, E, F, G and unclassified. Obtaining five or more GCSEs at grades A\* to C is referred to as “achieving level 2” at GCSE and is often an entry requirement for ‘A’ level courses, the most common type of qualification sought by pupils aged 16-18. The proportion of pupils achieving level 2 is published annually for schools and for education authorities by the Department for Education and Skills as one of several key performance indicators.

<sup>2</sup> The questionnaires and technical reports are available via the UK Data Archive in the appendices of the YCS User Guide at <http://www.data-archive.ac.uk/findingdata/snDescription.asp?sn=4571&key=YCS>.

surveys were sent a £5 voucher, while the control groups received no incentive. Additionally, in the postal survey the incentives were either unconditional (the incentive was sent with the initial mailing) or conditional (the voucher was promised in the original mailing, but only sent on receipt of a completed questionnaire). At waves 3 and 4, all incentives were paid unconditionally.

### **3.3 Allocation of Respondents to Modes and Incentive Treatments**

At wave 2, wave 1 respondents were randomly assigned to either telephone or postal mode.<sup>3</sup> The allocation of incentive treatments was however done at the school level (randomised cluster assignment by mode). Each school represented in the sample was allocated to one telephone treatment (control or incentive) and independently allocated to one, potentially different, postal treatment (control, unconditional incentive or conditional incentive), so that all sample members from the same school approached in the same mode received the same incentive treatment.

The 4712 wave 1 lower achiever respondents were stratified by serial number within school within Government Office Region and alternately allocated to telephone and postal treatments. We have excluded from the analysis 627 cases for which there was no valid telephone number on file, as those amongst this group who had been allocated to telephone mode were approached by post. Consequently, analysis of lower achievers is restricted to 2097 approached by telephone and 1988 approached by post.

A similar procedure was carried out for higher achievers, except that a larger proportion was allocated to postal treatment. There were 8909 wave 1 higher achiever respondents of which 751 had no valid telephone number and are excluded from the analysis. After these exclusions there are 2922 higher achievers allocated to telephone mode and 5236 allocated to postal mode.

For the allocation of schools to incentive treatment groups, the schools containing telephone sample members were stratified according to the ratio of lower to higher achievers in the sample and randomly assigned to incentive treatments within strata.<sup>4</sup> The procedure

---

<sup>3</sup> This excluded 64 wave 1 respondents who were used for the wave 2 pilot and not issued at any of the experimental waves.

<sup>4</sup> In the telephone strata the proportion of schools assigned to incentives was 1/2 if the ratio of lower to higher achievers in the sample was  $\geq 2$ ; 1/3 for  $0.5 \leq \text{ratio} < 2$  and 1/4 for all remainder schools. In the postal strata the proportions were 2/3 if the ratio was  $\geq 2$ ; 1/3 for  $0 \leq \text{ratio} < 0.5$  and 1/6 for all other schools.

was repeated for the allocation of schools in the postal treatment groups, where those selected for incentive treatment were randomly split into a conditional and an unconditional treatment group. All estimates of significance presented in this text account for the clustered sampling design of the incentive experiment.

Table 1 shows the issued sample sizes at each wave for the different treatment and mode combinations, excluding cases of known ineligibility who had either moved abroad or died (N=13 at wave 2; N=3 at wave 3). Ineligible cases at wave 4 are not identified in the data, but the number is likely to be small. The analysis also excludes wave 1 respondents for whom no telephone number was known at the time of the allocation to modes for wave 2, as described above, and 117 higher achievers assigned to telephone mode at wave 2, who responded by post and were subsequently allocated to postal mode.

< Table 1 >

Table 1 also documents the observed wave-on-wave and cumulative response rates (AAPOR RR1). The rates are shown by achievement level and sequential mode/incentive combination. Wave-on-wave response rates for the higher achiever sample allocated to telephone control at wave 2 and moved to postal control at wave 4 (Col 1) were, for example, 76.82%, 69.13% and 72.21%. The issued numbers of cases declined from 2,075 to 1,101 across the three waves, because nonrespondents were not issued in subsequent waves.

#### 4 Outcome measures and methods

The analysis is based on the sample of wave 1 respondents, since the experimental treatment allocations used information collected in the first wave and the corresponding characteristics of wave 1 nonrespondents are unknown. The response rate at wave 1 (AAPOR RR1) was 54.80%, excluding 5 cases of known ineligibility (Russell and Phelps 2001). This section describes the outcome measures and methods used to evaluate the hypotheses about the effects of incentives.

##### 4.1 Attrition

To test the effect of incentives on attrition, we estimated the probability of attrition as a function of the experimental design variables (*telephone mode, unconditional incentives, conditional incentives, lower achievers*) and their interactions. For each of the three experimental waves ( $t=2,3,4$ ), we estimated a separate probit model of the probability of attrition, in each case using the wave 1 respondent sample as the base:

$$\Pr(\text{attrition}_{it}) = F(\beta_{0t} + \beta_{1t}tel_i + \beta_{2t}unc_i + \beta_{3t}cond_i + \beta_{4t}la_i + \beta_{5t}tel_i * unc_i + \beta_{6t}la_i * tel_i + \beta_{7t}la_i * unc_i + \beta_{8t}la_i * cond_i + \beta_{9t}la_i * tel_i * unc_i + \varepsilon_i) \quad (1)$$

where  $F$  is the probit link function. The estimated coefficients and standard errors from this model were then used to calculate predicted probabilities of attrition under different treatment conditions and to test for differences due to incentives.

#### 4.2 Item nonresponse

To test the effect of incentives on item NR, we estimated count models of the number of items missing, using all non-routed items from the core questionnaires in waves 2 (N=44), 3 (N=48) and 4 (N=46), where ‘don’t know’ was counted as a missing value. We used the same specification of the predictors as for model (1) above, to estimate separate negative binomial regression models for each of the three experimental waves, conditional on response to the given wave. Overdispersion meant that Poisson models did not fit the data: the P-value of the Likelihood Ratio test of equal mean and variance was 0.0000 for all three waves. The estimated coefficients and standard errors from these models were used to calculate predicted item NR under different treatment conditions and to test for differences due to incentives.

#### 4.3 Attrition bias

To test the effect of incentives on attrition bias, we estimated the probability of attrition using model (1) and including wave 1 respondent characteristics and their interactions with the experimental design variables as predictors. We estimated separate probit models for attrition at each of the experimental waves ( $t=2,3,4$ ) and for each characteristic, again using the wave 1 respondent sample as the base:

$$\Pr(\text{attrition}_{it}) = F(\beta_{0t} + \beta_{1t}tel_i + \beta_{2t}unc_i + \beta_{3t}cond_i + \beta_{4t}la_i + \beta_{5t}tel_i * unc_i + \beta_{6t}la_i * tel_i + \beta_{7t}la_i * unc_i + \beta_{8t}la_i * cond_i + \beta_{9t}la_i * tel_i * unc_i + \beta_{10}wlchar + \beta_{11}wlchar_i * tel_i + \dots + \beta_{19}la_i * tel_i * unc_i + \varepsilon_i) \quad (2)$$

where  $\beta_{11}$  to  $\beta_{19}$  are the coefficients for the interactions of the characteristic with the design variables. The coefficient for the respondent characteristic,  $\beta_{10}$ , provides information about the direction, magnitude and, in combination with its standard error, the significance of attrition bias. The interaction of the characteristic and the incentive indicators provide information about the change in attrition bias due to incentives.<sup>5</sup>

---

<sup>5</sup> The significance of all interactions presented in this text was calculated following recommendations for nonlinear models by Norton, Wang and Ai (2004) using the command ‘predictnl’ in Stata version 9.

The characteristics tested were sample composition variables (gender, school type, exam results), current activity (full-time education, employment or neither in education, employment nor training; unemployment; studying for vocational or academic qualifications), household composition (living with parent, partner) and a set of attitudinal questions about employment and training. The wording of all questions is documented in Table 6. The characteristics chosen were those for which respondents and nonrespondents could be expected to differ, based on previous studies of nonresponse in the YCS and other surveys and on nonresponse theories (Groves and Couper 1998; Lynn et al. 1994).

#### **4.4 Reported results**

Since coefficients from non-linear models cannot be interpreted substantively (Long 1997), we report predicted values based on the model estimates, rather than coefficients. Unless stated otherwise, the results are for the higher achiever group. To convey a sense of the magnitude of differences in outcomes across treatments, we report transformations of the predicted values, comparing each treatment with the comparison group, the higher achiever postal control.

### **5 Attrition, item NR and attrition bias in the control groups**

As a background to the evaluation of the effects of incentives, this section documents the extent of attrition, item NR and attrition bias in the control groups, highlighting differences across waves, achievement levels and modes. Throughout the discussion the higher achiever postal control group is the reference category, with which all other treatments are compared.

#### **5.1 Attrition**

The predicted cumulative attrition rate among higher achievers allocated to the postal control group, increased from 21.77% in wave 2 to 56.53% in wave 4 (Table 2, Col 1). For *lower achievers* (Col 2), attrition rates in the postal control group were 61% higher at wave 2, but this difference decreased across waves to 29% at wave 4. The difference by achievement level was nonetheless significant in all three waves (P-value of  $\beta_4 = 0.0000$  for  $t=2,3,4$ ). In *telephone mode* (Col 3), attrition rates in the control group were not significantly different at wave 2, but 9% higher at wave 3 (P-value of  $\beta_5 = 0.0034$  for  $t=3$ ). This is contrary to findings from other studies, where nonresponse is generally lower in telephone mode due to the role of the interviewer in persuading respondents to take part in the survey. One possible reason for finding the opposite in this study, is that postal nonrespondents were followed up by

telephone, while telephone nonrespondents were not followed up. Secondly, the burden of the wave 2 survey (measured by the interview length) was higher for the telephone respondents due to the additional modules, possibly leading to higher nonresponse at wave 3 than among the postal sample. The predicted cumulative response rates, which were the base for the calculation of percentage differences across treatment groups, are documented in the first three columns of Table 5.

< Table 2 >

## 5.2 Item nonresponse

The predicted number of missing items in the higher achiever postal control group was 2.89 at wave 2, falling to 1.75 at wave 4 (Table 3, Col 1). For *lower achievers* (Col 2), the expected count for the control group was 21% higher at wave 2, with the gap increasing to 45% at wave 4. The differences by achievement level were significant in all three waves ( $P \leq 0.0001$  for  $\beta_4$ ,  $t=2,3,4$ ). For *telephone mode* (Col 3), the expected count was 4% lower at wave 2 and 12% lower at wave 3 ( $P=0.0000$  for  $\beta_5$ ,  $t=2,3$ ). The predicted item NR counts, used as the base for the calculations presented in Table 3, are documented in columns 4 to 6 of Table 5.

< Table 3 >

## 5.3 Attrition bias

Nonresponse in the higher achiever postal control group was differential for all of the domains tested (Table 4). The respondent samples significantly overrepresented those living with their parents, in full-time education or studying for academic qualifications. Predicted attrition rates for those in full-time education in the higher achiever postal control group, for example, were 14% lower than for those not in full-time education at wave 2, with the difference increasing to 17% by wave 4 ( $P=0.0000$  for  $\beta_{10}$ ,  $t=2,3,4$ ). At the same time, the respondent samples under-represented males, those in modern schools, with low or no exam results, who thought employers did not give young people the right training and that making plans for the future was a waste of time, those in full-time employment, who had experienced unemployment or were studying for vocational qualifications. Bias was particularly strong for those without any or very low exam qualifications, who were around 50% more likely to have attrited from the sample by waves 3 and 4, compared to sample members with better qualifications. Similarly, those in full-time employment were 17% more likely than those not in employment to drop out at wave 2, with the difference increasing to 22% by wave 4.

#### < Table 4 >

Including background information used by the YCS for weighting (gender, school type, exam results and region) in the models did not affect the bias for any of the characteristics (in each wave and for each item, the P-value > 0.05 from Wald tests of the equality of  $\beta_{10}$  estimated with and without background characteristics; not reported), except for bias for low qualifications (1 to 4 exams with grades D to G), for which bias was somewhat reduced when the background information was included.

The extent of attrition bias was mostly stable across waves. In the higher achiever postal control sample, the under-representation of males significantly increased from waves 2 to 4 (P-value from a Wald test of the equality of  $\beta_{10}$  across the two waves = 0.0295; not reported). For some of the other characteristics, the bias significantly decreased across waves. NR bias associated with attending a modern school fell between waves 3 and 4 and bias associated with not having any qualifications fell between waves 2 and 3 and again between waves 3 and 4.

For lower achievers there were few differences in the extent of attrition bias (not reported). Bias by gender, that is the difference in predicted nonresponse rates between males and females, was 12% less than for higher achievers at wave 4 (P-value of the interaction between achievement level and gender was 0.0425 for  $t=4$ ), and bias by full-time employment was 4% less at wave 2 (P-value = 0.0269 for  $t=2$ ); bias according to attitudes on training provided by employers was 9% higher at wave 2 (P-value = 0.0056); bias according to whether studying for academic or vocational qualifications was higher at wave 2 (22% and 13%), 6% lower and 1% higher at wave 3, and lower at wave 4 (81% and 92%).

Attrition bias in telephone mode was no different from postal mode, except for differential NR by gender: the bias was 7% less at wave 2, 2% less at wave 3 and 1% more at wave 4 (P-value of the interaction between telephone mode and gender was  $\leq 0.002$  for  $t=2,3,4$ ).

## **6 Evaluation of hypotheses**

The evidence discussed here is summarised in Table 2 (effects of incentives on attrition), Table 3 (effects on item NR), Table 4 (effects on attrition bias) and Table 5 (net effect on unit and item NR).

### *H1: Effects of incentives on attrition rate, attrition bias and item NR*

Incentives reduced attrition and increased item NR, but did not impact on attrition bias. Unconditional incentives reduced cumulative *attrition* in the postal higher achiever sample (Table 2, Col 4) by 38% (corresponding to an 8 percentage point difference) at wave 2, 32% at wave 3 and 30% at wave 4 (P-value of  $\beta_2=0.0000$  for  $t=2,3,4$ ). At the same time, the incentive increased *item NR* by 10% at wave 2 and 17% at wave 3 (P-value of  $\beta_2 \leq 0.05$  for  $t=2,3$ ), but had no effect at wave 4 (Table 3, Col 4). The difference across waves was however not significant (see H2).

Incentives had a proportionate effect on attrition across all respondent characteristics tested and therefore did not reduce *attrition bias*: the P-value of the interaction of unconditional incentives and respondent characteristics was  $>0.05$  for all characteristics and waves (not reported). The exception was the proportion of pupils in ‘modern’ schools who were under-represented in all three waves. (Modern schools were the smallest category, representing only 2.8% of the wave 1 respondent sample.) Unconditional incentives reduced this bias by 60%, 47% and 78% at waves 2, 3 and 4 (P-values of the interaction of incentives and modern school  $\leq 0.01$  for  $t=2,3,4$ ).

< Table 5 >

Since incentives had both positive and negative effects on response, Table 5 documents the net effect on the amount of information collected in the survey. The benefits of incentives in terms of unit NR clearly outweighed the cost in terms of item NR. For each sample persons issued at wave 2, the predicted unit and item response rates for the postal higher achiever sample, for example, implied that by wave 4, 40% more valid items were collected with unconditional incentives compared to the control group. For lower achievers, 50% more information was collected with incentives. This is, however, a crude measure of the net effect of incentives, since in a multivariate analysis or for analyses of change, different patterns of missingness across items or across waves may lead to large numbers of cases being dropped by pairwise deletion.

### *H2: Effects of incentives across waves*

The effect on attrition decreased somewhat across waves, while the effects on item NR and attrition bias were constant. Incentives reduced attrition by -38% at wave 2, -32% at wave 3 and -30% at wave 4 (Table 2, Col 4). The effects were comparable at waves 2 and 3, but significantly different between waves 2 and 4 and between waves 3 and 4 (P-value from a

Wald test of the equality of  $\beta_2$  across waves was  $\leq 0.05$ ). Although the relative effect of incentives decreased, , the absolute effect increased across waves (-17 percentage points at wave 4, compared to -8 and -14 at waves 2 and 3, see Table 5). The effect of incentives on *item NR* was not significantly different across waves (P-value of equality of  $\beta_2$  across waves was  $> 0.05$ ), although the predicted numbers of missing items fell across waves. Similarly, the effects of incentives on *attrition bias* did not differ across waves.

### *H3: Conditional compared to unconditional incentives*

Unconditional incentives had more effect on attrition than conditional incentives, but comparable effects on item NR and attrition bias. For higher achievers, the conditional incentives used at wave 2, were only half as effective at reducing *attrition* as unconditional incentives (Table 2, Col 5) and the difference between the two conditions was significant (P-value from a Wald test of the equality of  $\beta_2$  and  $\beta_3$  was 0.0142). At the same time, conditional incentives increased *item NR* by 38% more than unconditional incentives (Table 3, Col 5), but the difference was not significant. Conditional incentives somewhat reduced *attrition bias* for a single characteristic: sample members in the control group studying for vocational qualifications at wave 1 were 6.8% more likely to drop out than those not studying for vocational qualifications. With conditional incentives the difference was 6.4% (P-value of the interaction of conditional incentives with this characteristic was  $\leq 0.05$  for  $t=2$ ).

### *H4: Differential effects by mode*

Incentives had more effect on attrition and item NR in postal than telephone mode, but no effect on attrition bias in either mode. In telephone mode, unconditional incentives had less than half the effect on *attrition* they had in postal mode for the higher achiever group (Table 2, Col 8). The difference was significant at wave 3 (P-value of the interaction between telephone mode and unconditional incentives was 0.0057) but not at wave 2. At wave 3, incentives increased *item NR* 5% less in telephone mode than in postal mode (P-value of the interaction was 0.0442), but the difference at wave 2 was not significant. The lack of effect of unconditional incentives on *attrition* was no different across the two modes.

### *H5: Effects of changes in mode or incentive treatment*

Changing the incentive condition or mode did not have lasting effects. Changing the treatment from conditional to unconditional incentives had no lasting effect on either *attrition*

or *item NR* ( $P > 0.05$  from Wald tests of the equality of  $\beta_2$  and  $\beta_3$  for  $t=3,4$ ) and the effects after the change in treatment were comparable to those for the sample allocated to unconditional incentives from the start (Tables 2 and 3, Col 5). Changing the survey mode from telephone to postal did not have a lasting effect on *attrition* or *item NR* either ( $P$ -value of the interaction for telephone mode and unconditional incentives  $> 0.05$  at  $t=4$ ) and the effects after the change in mode were no different from the effects for the sample allocated to postal unconditional incentives from the start (Tables 2 and 3, Col 8).

#### *H6: Differential effects by ability level*

The effects of incentives were comparable across achievement levels. Although there were differences in the proportional effects of unconditional and conditional incentives on *attrition* and *item NR* by achievement level, these were not significant (Cols 6 and 7 in Tables 2 and 3 report the  $P$ -values of the interactions of achievement level with each of the incentive treatments), since the absolute effects were comparable. Unconditional incentives, for example, reduced *attrition* at wave 2 by 8 percentage points among higher achievers and 10 percentage points among lower achievers. However, since the level of nonresponse in the control group was 61% higher for the lower achiever group, the comparable absolute effect implied a smaller proportional effect of only 76% of the effect for higher achievers.

Similarly, the difference between modes was not differential by achievement (Tables 2 and 3, Col 9 report the  $P$ -values of the interaction between achievement level, unconditional incentives and telephone mode) and the lack of effect on *attrition bias* was no different for lower achievers (not reported).

## **7 Summary and discussion**

This study has provided new evidence on the effects of continued incentive payments in a multi-mode panel study. We tested the effects of incentives on attrition, item NR and attrition bias and whether these effects changed across waves. We also tested whether conditional and unconditional incentives had comparable effects, whether incentive effects were differential across modes and ability levels, and whether changes in the incentive treatment or mode had lasting impact on the effect of incentives in subsequent waves.

The findings showed that unconditional incentives significantly reduced attrition and, although they also increased item NR, the net effect on the amount of information collected by the survey was positive. Incentives had proportionate effects across a range of respondent characteristics and as a result did not impact on attrition bias in terms of those characteristics.

Item NR was reduced more by unconditional than conditional incentives, and more in postal than in telephone mode. Attrition bias was not affected by incentives, regardless of incentive treatment or mode. Across waves, incentives had somewhat decreasing effect on attrition, but comparable effects on item NR. The lack of effect on attrition bias was also a constant across waves. Changes in incentive treatment from conditional to unconditional, and in mode from telephone to postal, did not affect outcomes at later waves.

The findings imply that respondent incentives are an effective means of maintaining sample sizes of a panel and ensuring its value in terms of efficiency of estimation and feasibility of subgroup analyses. Among lower achievers, fully 50% more information was collected during the three experimental waves, in terms of the number of valid items per case issued at the start. Incentives were safe, in the sense that increased response rates did not inadvertently increase NR bias in terms of observed characteristics.

Changes in incentive treatment did not have lasting effect; however, in this study the only change implemented was an improvement for the respondent, from conditional to unconditional incentives. Expectations formed on the basis of previous incentive treatments may well mean that changes have lasting effect, if the change reduces the value of the incentive in the eyes of the respondent (see, Singer, Van Hoewyk, and Maher 1998).

Incentives had no effect on attrition bias. We could however not evaluate the effect on bias of NR at wave 1. Ideally, we would compare both the magnitude of bias due to NR at wave 1 and due to subsequent attrition, and the effects of incentives on both. It is likely that NR at wave 1 is more detrimental in terms of bias than later attrition, especially in studies such as the present one with low initial response rates. In this case, the effect of incentives on bias at wave 1 is potentially more important than any effect on bias caused by attrition. In addition, the discussion of the effects of incentives on attrition bias has focused entirely on observed characteristics and although incentives did not have differential effects in terms of these, they may nonetheless have differential effects in terms of unobserved factors. If this were the case, the use of respondent incentives could introduce sample selection bias in multivariate estimates, if the unobservables determining the responsiveness to incentives are correlated with outcomes measured by the survey (Kennedy 2003). For example, if responsiveness to incentives depends on time preferences for money and this factor also determines the decision to leave further education and work instead, then models of the determinants of educational outcomes will lead to biased estimates.

Finally, there was little evidence that the respondent sample became less sensitive to incentives across waves as potentially less committed sample members dropped out. This

finding is consistent with Laurie (2006), who reported that an increase in the value of an incentive in the British Household Panel Survey significantly increased response, even after 14 waves of the panel, with already high annual response rates of around 95% each year. Since previous studies have found that the effects of one-off incentives can carry over across waves (James 1997; Laurie and Lynn forthcoming; Mack et al. 1998), a formal test of marginal effects of incentives would however require comparisons with a treatment group only offered an incentive at the first wave.

## References

- Armstrong, J. Scott. 1975. "Monetary Incentives in Mail Surveys." *Public Opinion Quarterly* 39:111-116.
- Berk, Marc L., Nancy A. Mathiowetz, Edward P. Ward, and Andrew A. White. 1987. "The Effect of Prepaid and Promised Incentives: Results of a Controlled Experiment." *Journal of Official Statistics* 3:449-457.
- Church, Allan H. 1993. "Estimating the Effect of Incentives on Mail Survey Response Rates: A Meta-Analysis." *Public Opinion Quarterly* 57:62-79.
- Davern, Michael, Todd H. Rockwood, Randy Sherrod, and Stephen Campbell. 2003. "Prepaid Monetary Incentives and Data Quality in Face-to-Face Interviews: Data from the 1996 Survey of Income and Program Participation Incentive Experiment." *Public Opinion Quarterly* 67:139-147.
- Downs, Barbara. 1999. "Incentive Use in Panel Surveys." Internal Census Bureau Memorandum.
- Fox, Richard J., Melvin R. Crask, and Jonghoon Kim. 1988. "Mail Survey Response Rate: A Meta-Analysis of Selected Techniques for Inducing Response." *Public Opinion Quarterly* 52:467-491.
- Gouldner, Alvin. 1960. "The Norm of Reciprocity: A Preliminary Statement." *American Sociological Review* 25:161-78.
- Goyder, John. 1994. "An Experiment with Cash Incentives on a Personal Interview Survey." *Journal of the Market Research Society* 36:360-366.
- Groves, Robert M. and Mick P. Couper. 1998. *Nonresponse in Household Interview Surveys*. New York: John Wiley.
- Groves, Robert, Eleanor Singer, and Amy Corning. 2000. "Leverage-Salience Theory of Survey Participation: Description and an Illustration." *Public Opinion Quarterly* 64:299-308.
- Hopkins, Kenneth D. and Arlen R. Gullickson. 1992. "Response Rates in Survey Research: A Meta-Analysis of the Effects of Monetary Gratuities." *Journal of Experimental Education* 61:52-62.
- James, Jeannine M. and Richard Bolstein. 1990. "The Effect of Monetary Incentives and Follow-Up Mailings on the Response Rate and Response Quality in Mail Surveys." *Public Opinion Quarterly* 54:346-361.
- James, Tracy L. 1997. "Results of Wave 1 Incentive Experiment in the 1996 Survey of Income and Program Participation." Pp. 834-839 in *Proceedings of the Survey Research Methods Section, American Statistical Association*. Alexandria, VA: American Statistical Association.
- Kennedy, Peter. 2003. *A Guide to Econometrics*. Oxford: Blackwell.

- Laurie, Heather. 2006. "The Effect of Increasing Financial Incentives in a Panel Survey: an Experiment on the British Household Panel Survey, Wave 14." Colchester: Unpublished Working Paper. University of Essex.
- Laurie, Heather and Peter Lynn. forthcoming. "The Use of Respondent Incentives on Longitudinal Surveys." in *Methodology of Longitudinal Surveys*, edited by P. Lynn. Colchester: University of Essex.
- Long, J.S. 1997. *Regression Models for Categorical and Limited Dependent Variables*. Thousand Oaks, CA: Sage.
- Lynn, Peter, Susan Purdon, Barry Hedges, and Ian McAleese 1994 'England and Wales Youth Cohort Study: An Assessment of Alternative Weighting Strategies.' *Employment Department Research Series YCS, No. 30*, Sheffield: Employment Department.
- Mack, Stephen, Vicki Huggins, Donald Keathley, and Mahdi Sundukchi. 1998. "Do Monetary Incentives Improve Response Rates in the Survey of Income and Programme Participation?" Pp. 529-534 in *Proceedings of the Survey Research Methods Section, American Statistical Association*. Alexandria, VA: American Statistical Association.
- Martin, Elizabeth, Denise Abreu, and Franklin Winters. 2001. "Money and Motive: Effects of Incentives on Panel Attrition in the Survey of Income and Program Participation." *Journal of Official Statistics* 17:267-284.
- Mason, Robert, Virginia Lesser, and Michael W. Traugott. 2002. "Effect of Item Nonresponse on Nonresponse Error and Inference." Pp. 149-161 in *Survey Nonresponse*, edited by R. M. Groves, D. A. Dillman, J. L. Eltinge, and R. J. A. Little. New York: John Wiley.
- Menard, Scott. 2002. *Longitudinal research*. Thousand Oaks: Sage.
- Rodgers, Willard. 2002. "Size of Incentive Effects in a Longitudinal Study." Pp. 2930-2935 in *Proceedings of the Survey Research Methods Section, American Statistical Association*. Alexandria, VA: American Statistical Association.
- Russell, Neil and Andrew Phelps. 2001. "Youth Cohort Study Cohort 10 Sweep 1: Technical Report." London: Taylor Nelson Sofres.
- Ryu, Erica, Mick P. Couper, and Robert W. Marans. 2006. "Survey Incentives: Cash vs. In-Kind; Face-to-Face vs. Mail; Response Rate vs. Nonresponse Error." *International Journal of Public Opinion Research* 18:89-106.
- Sala, Emanuela and Peter Lynn 2004 'The Effect of Dependent Interviewing on Measures of Employment Characteristics', *ISER Working Paper, No. 2004-26*, Colchester: University of Essex. <http://www.iser.essex.ac.uk/pubs/workpaps/pdf/2004-26.pdf>
- Shettle, Carolyn and Geraldine Mooney. 1999. "Monetary Incentives in U.S. Government Surveys." *Journal of Official Statistics* 15:231-250.
- Singer, Eleanor, John Van Hoewyk, Nancy Gebler, Trivellore Raghunathan, and Katherine McGonagle. 1999. "The Effect of Incentives on Response Rates in Interviewer-Mediated Surveys." *Journal of Official Statistics* 15:217-230.
- Singer, Eleanor, John Van Hoewyk, and Mary P. Maher. 1998. "Does the Payment of Incentives Create Expectation Effects?" *Public Opinion Quarterly* 62:152-164.
- . 2000. "Experiments with Incentives in Telephone Surveys." *Public Opinion Quarterly* 64:171-188.
- Stratford, Nina, Nadine Simmonds, and Gerry Nicolaas. 2003. "National Travel Survey 2002: Report on Incentives Experiment." London: National Centre for Social Research.
- Teisl, Mario F., Brian Roe, and Mike Vayda. 2005. "Incentive Effects on Response Rates, Data Quality, and Survey Administration Costs." *International Journal of Public Opinion Research* 18:364-373.

- Tzamourani, Panagiota and Peter Lynn 1999 'The Effect of Monetary Incentives on Data Quality - Results from the British Social Attitudes Survey 1998 Experiment', *CREST Working Paper, No. 73*, Oxford: University of Oxford.
- Ward, R. Kay, Scott Boggess, Kandasamy Selvavel, and Michael F. McMahon. 2001. "The Use of Targeted Incentives to Reluctant Respondents on Response Rates and Data Quality." in *Proceedings of the Survey Research Methods Section, American Statistical Association*. Alexandria, VA: American Statistical Association.
- Willimack, Diane K., Howard Schuman, Beth-Ellen Pennell, and James M. Lepkowski. 1995. "Effects of a Prepaid Nonmonetary Incentive on Response Rates and Response Quality in a Face-to-Face Survey." *Public Opinion Quarterly* 59:78-92.
- Yu, Julie and Harris Cooper. 1983. "A Quantitative Review of Research Design Effects on Response Rates to Questionnaires." *Journal of Marketing Research* 20:36-44.

**Figure 1: Experimental design**

| Wave 1        | Postal core questionnaire. Reported exam results used to classify respondents for wave 2 allocation. |                |                |                |                |                                 |                |                |                |                |
|---------------|--|----------------|----------------|----------------|----------------|---------------------------------|----------------|----------------|----------------|----------------|
|               | Higher Achievers   |                |                |                |                | Lower Achievers                 |                |                |                |                |
| Wave 2        | T <sub>x</sub>   | T <sub>u</sub> | P <sub>x</sub> | P <sub>u</sub> | P <sub>c</sub> | T <sub>x</sub>                  | T <sub>u</sub> | P <sub>x</sub> | P <sub>u</sub> | P <sub>c</sub> |
| Wave 3        | T <sub>x</sub>   | T <sub>u</sub> | P <sub>x</sub> | P <sub>u</sub> | --             | --                              | --             | P <sub>x</sub> | P <sub>u</sub> | --             |
| Wave 4        | --   | --             | P <sub>x</sub> | P <sub>u</sub> | --             | --                              | --             | P <sub>x</sub> | P <sub>u</sub> | --             |
| Questionnaire | Core + Higher education  |                |                | Core           |                | Core + Education and employment |                |                | Core           |                |

Notes: T=telephone, P=postal, x=control, u=unconditional incentive, c=conditional incentive. Arrows indicate changes in incentive treatment or mode allocation between waves.

**Table 1: Conditional and cumulative response rates**

| Wave | Response Rate %           | Higher Achievers                             |  |  |  |  | Lower Achievers                              |  |  |  |  |
|------|---------------------------|--|--|--|--|--|--|--|--|--|--|
|      |                           | T <sub>x</sub> T <sub>x</sub> P <sub>x</sub> | T <sub>u</sub> T <sub>u</sub> P <sub>u</sub> | P <sub>x</sub> P <sub>x</sub> P <sub>x</sub> | P <sub>u</sub> P <sub>u</sub> P <sub>u</sub> | P <sub>c</sub> P <sub>u</sub> P <sub>u</sub> | T <sub>x</sub> P <sub>x</sub> P <sub>x</sub> | T <sub>u</sub> P <sub>u</sub> P <sub>u</sub> | P <sub>x</sub> P <sub>x</sub> P <sub>x</sub> | P <sub>u</sub> P <sub>u</sub> P <sub>u</sub> | P <sub>c</sub> P <sub>u</sub> P <sub>u</sub> |
| 2    | Conditional<br>(Issued N) | 76.82<br>(2,075)                             | 80.91<br>(728)                               | 78.23<br>(3,262)                             | 86.45<br>(1,004)                             | 82.32<br>(967)                               | 65.21<br>(1,282)                             | 70.41<br>(811)                               | 64.93<br>(807)                               | 75.00<br>(608)                               | 71.35<br>(569)                               |
| 3    | Conditional<br>(Issued N) | 69.13<br>(1,594)                             | 73.17<br>(589)                               | 73.07<br>(2,551)                             | 81.91<br>(868)                               | 81.36<br>(794)                               | 59.09<br>(836)                               | 70.93<br>(571)                               | 63.36<br>(524)                               | 71.93<br>(456)                               | 70.20<br>(406)                               |
|      | Cumulative                | 53.11  | 59.20  | 57.16  | 70.82  | 66.94  | 38.53  | 49.94  | 41.14  | 53.95  | 50.09  |
| 4    | Conditional<br>(Issued N) | 72.21<br>(1,101)                             | 85.61<br>(431)                               | 76.11<br>(1,863)                             | 85.65<br>(711)                               | 86.82<br>(645)                               | 63.16<br>(494)                               | 74.26<br>(404)                               | 65.36<br>(332)                               | 75.30<br>(328)                               | 81.34<br>(284)                               |
|      | Cumulative                | 38.31  | 50.69  | 43.48  | 60.66  | 58.03  | 24.34  | 36.99  | 26.89  | 40.63  | 40.60  |

Notes: AAPOR Response Rate 1. Treatment groups are identified by T=telephone, P=postal, x=control, u=unconditional incentive, c=conditional incentive. T<sub>x</sub>T<sub>x</sub>P<sub>x</sub> for example, refers to the sample allocated to telephone control at waves 2 and 3 and to postal control at wave 4. Conditional response rates are conditional on response at the previous wave. The base is the number of issued cases, which excludes previous wave nonrespondents and ineligible cases. Cumulative response rates are the percentage of wave 1 respondents remaining in the respondent sample. The base is the wave 2 number of issued cases, excluding three higher achievers ineligible at wave 3 (1 P<sub>x</sub>P<sub>x</sub>P<sub>x</sub> and 2 P<sub>c</sub>P<sub>u</sub>P<sub>u</sub>).

**Table 2: Effect of incentives on attrition rates**

| Wave      | Control groups |  |  | Incentives                             |   | Incentives by ability       |   | Incentives by mode and ability                      |   |
|-----------|----------------|--|--|--|---|-----------------------------|---|---|---|
|           | (1)            | (2)                                    | (3)                                    | (4)                                    | (5)   | (6)                         | (7)   | (8)   | (9)   |
|           | $P_x^{ha}$     | $\frac{P_x^{la} - P_x^{ha}}{P_x^{ha}}$ | $\frac{T_x^{ha} - P_x^{ha}}{P_x^{ha}}$ | $\frac{P_u^{ha} - P_x^{ha}}{P_x^{ha}}$ | $\frac{(P_c^{ha} - P_x^{ha}) / P_x^{ha}}{(4)^{ha}}$ | $\frac{(4)^{la}}{(4)^{ha}}$ | $\frac{(P_c^{la} - P_x^{la}) / P_x^{la}}{(P_c^{ha} - P_x^{ha}) / P_x^{ha}}$ | $\frac{(T_u^{ha} - T_x^{ha}) / T_x^{ha}}{(4)^{ha}}$ | $\frac{(T_u^{la} - T_x^{la}) / T_x^{la}}{(T_u^{ha} - T_x^{ha}) / T_x^{ha}}$ |
| 2         | 21.77          | 0.6112                                 | 0.0650                                 | -0.3777                                | 0.4966  | 0.7602                      | 0.9763  | 0.4669  | 0.8471  |
| (P-Value) |                | (0.0000)                               | (0.2268)                               | (0.0000)                               | (0.0142)  | (0.5085)                    | (0.4332)  | (0.0556)  | (0.6810)  |
| 3         | 42.86          | 0.3734                                 | 0.0941                                 | -0.3191                                | 0.7066  | 0.6820                      | 0.6743  | 0.4074  | 1.4275  |
| (P-Value) |                | (0.0000)                               | (0.0034)                               | (0.0000)                               | (0.0592)  | (0.7834)                    | (0.8287)  | (0.0057)  | (0.0861)  |
| 4         | 56.53          | 0.2933                                 | –                                      | -0.3040                                | 0.8402  | 0.6179                      | 0.7340  | 0.6597  | 0.8338  |
| (P-Value) |                | (0.0000)                               | –                                      | (0.0000)                               | (0.2244)  | (0.2535)                    | (0.8177)  | (0.0911)  | (0.9265)  |

Notes: P=postal, T=telephone, x=control, u=unconditional incentive, c=conditional incentive, ha=higher achievers, la=lower achievers. Column (1) shows the predicted attrition rate for the postal control higher achiever sample. The remaining columns show proportionate change in predicted rates. P-values of columns 2–4 represent standard errors of the main effects in the probit model; column 5 represents P-values from a Wald test of the equality of the coefficients for conditional and unconditional incentives; columns 7–9 represent P-values for the relevant interactions calculated using 'predictnl' in Stata version 9, according to Norton, Wang, and Ai (2004).

**Table 3: Effect of incentives on item nonresponse (counts)**

| Wave      | Control groups |  |  | Incentives                             |   | Incentives by ability       |   | Incentives by mode and ability                      |   |
|-----------|----------------|--|--|--|---|-----------------------------|---|---|---|
|           | (1)            | (2)                                    | (3)                                    | (4)                                    | (5)   | (6)                         | (7)   | (8)   | (9)   |
|           | $P_x^{ha}$     | $\frac{P_x^{la} - P_x^{ha}}{P_x^{ha}}$ | $\frac{T_x^{ha} - P_x^{ha}}{P_x^{ha}}$ | $\frac{P_u^{ha} - P_x^{ha}}{P_x^{ha}}$ | $\frac{(P_c^{ha} - P_x^{ha}) / P_x^{ha}}{(4)^{ha}}$ | $\frac{(4)^{la}}{(4)^{ha}}$ | $\frac{(P_c^{la} - P_x^{la}) / P_x^{la}}{(P_c^{ha} - P_x^{ha}) / P_x^{ha}}$ | $\frac{(T_u^{ha} - T_x^{ha}) / T_x^{ha}}{(4)^{ha}}$ | $\frac{(T_u^{la} - T_x^{la}) / T_x^{la}}{(T_u^{ha} - T_x^{ha}) / T_x^{ha}}$ |
| 2         | 2.89           | 0.2068                                 | -0.9579                                | 0.1008                                 | 1.3849  | 2.4825                      | 0.6927  | 0.1820  | -0.4094   |
| (P-Value) |                | (0.0005)                               | (0.0000)                               | (0.0173)                               | (0.4790)  | (0.1308)                    | (0.6472)  | (0.6251)  | (0.9202)  |
| 3         | 2.54           | 0.3879                                 | -0.8828                                | 0.1660                                 | 1.5599  | 1.6788                      | 1.2445  | -0.9526   | -0.1378   |
| (P-Value) |                | (0.0001)                               | (0.0000)                               | (0.0049)                               | (0.2372)  | (0.4339)                    | (0.6796)  | (0.0442)  | (0.3890)  |
| 4         | 1.75           | 0.4533                                 | –                                      | 0.0085                                 | 17.5491   | 16.8405                     | 0.4621  | 13.8706   | 2.3073  |
| (P-Value) |                | (0.0013)                               | –                                      | (0.9262)                               | (0.2133)  | (0.4724)                    | (0.6481)  | (0.5049)  | (0.4530)  |

Notes: P=postal, T=telephone, x=control, u=unconditional incentive, c=conditional incentive, ha=higher achievers, la=lower achievers. Column (1) shows the predicted number of missing items of 44 non-branched items at wave 2, 48 at wave 3 and 46 at wave 4. The remaining columns show proportionate change in predicted item NR counts. P-values of columns 2–4 represent standard errors of the exponentiated coefficients from the count model; column 5 represents P-values from a Wald test of the equality of the exponentiated coefficients for conditional and unconditional incentives; columns 7–9 represent P-values for the relevant interactions calculated using 'predictnl' in Stata version 9, according to Norton, Wang and Ai (2004).

**Table 4: Attrition bias (higher achiever postal control group)**

|  | Wave 2  | P-Value  | Wave 3  | P-Value  | Wave 4  | P-Value  |
|--|---------|----------|---------|----------|---------|----------|
| Male   | 0.0807  | (0.0000) | 0.1330  | (0.0000) | 0.1474  | (0.0000) |
| School type                                  |         |          |         |          |         |          |
| Comprehensive 16                             | 0.0196  | (0.2645) | 0.0102  | (0.6178) | 0.0259  | (0.2060) |
| Comprehensive 18                             | -0.0197 | (0.1966) | -0.0138 | (0.4444) | -0.0200 | (0.2650) |
| Selective                                    | -0.0188 | (0.3661) | -0.0547 | (0.0407) | -0.0213 | (0.4577) |
| Modern                                       | 0.2310  | (0.0001) | 0.2423  | (0.0004) | 0.1597  | (0.0261) |
| Independent                                  | -0.0142 | (0.4639) | 0.0147  | (0.5245) | -0.0068 | (0.7756) |
| Exam results                                 |         |          |         |          |         |          |
| 5+ grades A-C                                | -0.0977 | (0.1778) | -0.0866 | (0.3060) | -0.1795 | (0.0320) |
| 1-4 grades A-C                               | 0.0831  | (0.2857) | 0.0721  | (0.4298) | 0.1696  | (0.0606) |
| 5+ grades D-G                                | 0.0324  | (0.8769) | 0.0715  | (0.7739) | 0.1849  | (0.4536) |
| 1-4 grades D-G                               | -0.2177 | (0.0000) | 0.5714  | (0.0000) | 0.4347  | (0.0000) |
| None   | 0.7826  | (0.0000) | 0.5716  | (0.0000) | 0.4348  | (0.0000) |
| Attitudes                                    |         |          |         |          |         |          |
| Employers don't give training                | 0.0842  | (0.0000) | 0.0882  | (0.0000) | 0.0798  | (0.0001) |
| Training more important than pay             | 0.0108  | (0.4808) | -0.0070 | (0.6979) | -0.0062 | (0.7370) |
| Plans for future are a waste of time         | 0.0656  | (0.0959) | 0.1457  | (0.0015) | 0.1371  | (0.0030) |
| Information about opportunities              | 0.0034  | (0.8431) | -0.0204 | (0.3266) | -0.0236 | (0.2549) |
| Enough support planning future               | 0.0063  | (0.6771) | 0.0043  | (0.8233) | -0.0105 | (0.5848) |
| Current activity                             |         |          |         |          |         |          |
| In full-time education                       | -0.1371 | (0.0000) | -0.1462 | (0.0000) | -0.1728 | (0.0000) |
| In full-time employment                      | 0.1661  | (0.0003) | 0.1983  | (0.0001) | 0.2201  | (0.0000) |
| Neither in employment, education or training | 0.0898  | (0.1387) | 0.1036  | (0.1495) | 0.1098  | (0.1184) |
| ILO unemployed                               | 0.0112  | (0.6272) | 0.0573  | (0.0421) | 0.0475  | (0.0879) |
| Unemployed during past 12 months             | 0.0246  | (0.4216) | 0.0731  | (0.0523) | 0.0891  | (0.0146) |
| Studying for academic qualifications         | -0.1173 | (0.0000) | -0.1351 | (0.0000) | -0.1341 | (0.0000) |
| Studying for vocational qualifications       | 0.0677  | (0.0001) | 0.0882  | (0.0000) | 0.0721  | (0.0003) |
| Living arrangements                          |         |          |         |          |         |          |
| Living with parent                           | -0.1348 | (0.0111) | -0.1916 | (0.0027) | -0.1033 | (0.0986) |
| Living with partner                          | 0.0904  | (0.4457) | -0.0441 | (0.7475) | -0.1042 | (0.4525) |

Notes: Predicted differences in attrition rates based on  $\hat{\beta}_{10,t}$ , i.e. prediction for each category compared to all residual categories. Each table entry is from a different model as explained in the text. P-values based upon estimated standard errors of the coefficient for the characteristic in the probit model.

**Table 5: Net effect of incentives on unit and item response**

|           |                | Predicted cumulative RR (%) |       |       | Predicted mean # INR |      |      | # valid items per unit issued at w2:<br>incentive/control |       |       |       |
|-----------|----------------|-----------------------------|-------|-------|----------------------|------|------|---|-------|-------|-------|
|           |                | w2                          | w3    | w4    | w2                   | w3   | w4   | w2  | w3    | w4    |       |
| Higher    | P <sub>x</sub> | 78.23                       | 57.14 | 43.47 | 2.89                 | 2.54 | 1.75 | –   | –     | –     |       |
| Achievers | P <sub>u</sub> | 86.45                       | 70.82 | 60.66 | 3.19                 | 2.96 | 1.77 | 1.097   | 1.228 | 1.395 |       |
|           | P <sub>c</sub> | 82.32                       | 66.80 | 57.91 | 3.30                 | 3.20 | 2.01 | 1.042   | 1.152 | 1.324 |       |
|           | T <sub>x</sub> | 76.82                       | 53.11 | 38.31 | 0.12                 | 0.30 | 1.61 | –   | –     | –     |       |
|           | T <sub>u</sub> | 80.91                       | 59.20 | 50.69 | 0.12                 | 0.25 | 1.80 | 1.053   | 1.116 | 1.317 |       |
|           | P <sub>x</sub> | 64.93                       | 41.14 | 26.89 | 3.49                 | 3.52 | 2.54 | –   | –     | –     |       |
| Lower     | Achievers      | P <sub>u</sub>              | 75.00 | 53.95 | 40.63                | 4.37 | 4.51 | 2.91  | 1.130 | 1.282 | 1.498 |
|           | P <sub>c</sub> | 71.35                       | 50.09 | 40.60 | 3.83                 | 4.66 | 2.72 | 1.090   | 1.186 | 1.504 |       |
|           | T <sub>x</sub> | 65.21                       | 38.53 | 24.34 | 0.50                 | 3.48 | 2.35 | –   | –     | –     |       |
|           | T <sub>u</sub> | 70.41                       | 49.94 | 36.99 | 0.49                 | 3.56 | 2.99 | 1.080   | 1.294 | 1.498 |       |

Notes: RR=response rate, INR=item nonresponse, #=number. T=telephone, P=postal, x=control, u=unconditional incentive, c=conditional incentive. Calculation based on 44 non-branched items at wave2, 48 at wave 3 and 46 at wave 4. The number of valid items is calculated as  $RR_4 \cdot (44 - INR_2 + 48 - INR_3 + 46 - INR_4)$ .

**Table 6: Question wording of items included in analysis of nonresponse bias**

| Variable             | Question wording   |
|----------------------|--|
| Year 11 exam results | “Please tell us: a) Which GCSE subjects you studied in Years 10 and 11, b) Which GCSE subjects you have taken an exam in, c) Your GCSE results (do not record any re-sit results obtained in Year 11).”  |
| Attitudes:           | “Here are some things which people have said. We would like to know what you think. Please put a cross in one box for each statement: Agree, Disagree, Don’t know”   |
| ATT: employers       | Agree: “Most employers don’t give young people the right kind of training at work.”  |
| ATT: training/pay    | Agree: “In looking for a job, I am more concerned to find one with training than one that pays the best.”  |
| ATT: plans           | Agree: “I think that making plans for the future is a waste of time.”  |
| ATT: information     | Agree: “I know how to find out about future work, training or education opportunities.”  |
| ATT: support         | Agree: “I get enough support in planning my future.”   |
| Current activity:    | “Please put a cross against one box to tell us your main activity at the moment: a) Out of work/unemployed, b) Modern Apprenticeship, National Traineeship, Youth Training or other government supported training, c) In a full-time job (over 30 hours a week), d) In a part-time job (if this is your <u>main</u> activity), e) In full-time education at school or college, f) Looking after home or family, g) Doing something else (please specify).” |
| In ft education      | In full-time education   |
| In ft employment     | In full-time employment  |
| NEET                 | Not in employment, education or training   |
| ILO unemployed       | Unemployed and searching for job among economically active (YCS derived variable)  |
| Unemployed           | Unemployed in one or more months from April 1999 to March 2000.: “We would also like to know what you have been doing over the past months. Please put a cross in one box for each month to show us what you were doing for all, or most of each month.”<br>Response options as for current activity, including ‘On holiday’.  |
| Studying (ac)        | Yes: “At present, are you studying for GCSE, A/S or A-level qualifications?”   |
| Studying (voc)       | Yes: “At present, are you studying for any GNVQs (General National Vocational Qualifications)?” or “At present, are you studying for NVQ (National Vocational Qualification) or any other vocational or professional qualification including BTEC, City & Guilds or RSA qualifications?”   |
| Household:           | “Who lives in the same household as you? a) Father, b) Stepfather, c) Mother, d) Stepmother, e) Your own children, f) Brothers and sisters g) Other persons (please write in their relationship to you).”  |
| Living with parent   | Living with one or more of father, stepfather, mother or stepmother.   |
| Living with partner  | Living with boyfriend, girlfriend, husband, wife or partner.   |