

Measurement and adjustment of non-response bias based on non-response surveys: the case of Belgium and Norway in the European Social Survey Round 3

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In earlier rounds of the European Social Survey, non-response bias was studied by using population statistics and call record information (para data). In the third round, a new feature was introduced: two kinds of non-respondent surveys were set up using a short list of questions which were designed to study non-response bias. In Belgium, a very short questionnaire was offered to all refusals at the doorstep (doorstep questions survey, DQS). In Norway and two other countries, somewhat longer versions of the basic questionnaire were offered to all main survey non-respondents and to samples of respondents (non-response survey, NRS). Logistic regression models were applied in order to estimate response propensities. This paper shows that propensity score weighting adjustment of non-response bias, on the basis of key socio-demographic and attitudinal variables, is effective for most demographic and non-demographic variables in both Belgium and Norway. Application of the weighting procedure balances the samples of cooperative respondents and non-respondents according to the key variables studied since systematic differences between cooperative respondents and non-respondents have disappeared.

Keywords: non-response survey, non-response bias, propensity score weighting, data quality

1 Introduction

The number of surveys being conducted has increased over time but response rates are decreasing (de Heer 1999; Groves and Couper 1998; Groves 2006; Thomsen et al. 2006). The European Social Survey (ESS), a cross-national survey carried out according to the highest methodological standards, is no exception. For half of the 24 countries participating in ESS Round 4, the response rate has decreased as compared to ESS Round 3 – quite substantially in some instances. In five countries, the response rate decreased by over four percentage points (Matsuo et al. 2010).

The precise relationship between the response rate and non-response bias is the focus of our discussion. Although there is no automatic relationship between the response rate and the existence of bias (Groves 2006; Groves and Peytcheva 2008), the likelihood of bias generally increases

when response rates are lower, particularly when the factors that effect non-response are related to crucial variables in the population (Billiet et al. 2009). Since the level, nature and causes of non-response bias are likely to differ across countries, obtaining correct insights from survey responses in cross-national research is a difficult task (Stoop et al. 2010).

Based on the work of Groves (2006) on non-response bias in household surveys, four approaches to bias detection were studied (Billiet et al. 2009) in a joint research activity (JRA2) under the ESS infrastructure project, supported by the EU Research Framework Programme 6:

- (1) bias as the deviation between sample and population distributions (post-stratification weighting) (Vehovar 2007)
- (2) bias as the difference between cooperative and reluctant respondents (Billiet et al. 2007; Beullens et al. 2009a/b)
- (3) bias as the difference between different types of sample unit on the basis of observable data (Cincinatto et al. 2008; Matsuo and Billiet 2009); and
- (4) bias as the difference between cooperative respondents and non-respondents on the basis of additional surveys among non-respondents using a small set of carefully selected basic questions (Matsuo et al. 2009). This paper

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focuses on this last approach, a non-response survey.

Each of these methods uses information about the population, the total sample, and different kinds of sub-samples. In-depth analyses of these approaches revealed their main pros and cons. Some of the problems were: a weak relation between post-stratification variables and relevant target variables; the restriction of information to refusals (and not other non-response units) in the adjustment procedure; and the small number of relevant variables in, and poor data quality of, observable data in the contact files.

In order to estimate non-response bias and to adjust the sample, one can use information from non-respondents obtained through a small set of key questions. There are two approaches. In the so-called 'basic question procedure' (Bethlehem and Kersten 1985), non-respondents are visited shortly after the main survey, and they are asked a few questions. Bias is adjusted on the basis of this information using linear models. The Pre-Emptive Doorstep Administrator of Key Survey Items (PEDAKSI) approach is a variant of this 'basic question procedure': interviewers will pose a small number of key survey questions as soon as it becomes clear that the potential respondent will not participate in the survey (Lynn 2003).

The aim of this paper is to explore methods for adjusting non-response bias based on these two kinds of non-response surveys. This objective is achieved by studying the differences between respondents and non-respondents through the ESS main survey and non-response survey, by applying propensity score weighting, and by evaluating its effectiveness in several ways.

Our approach has several advantages over previous methods for adjusting non-response bias. First, given the wide range of key questions included in the non-response survey, different types of information, both demographic and non-demographic (behavioural and attitudinal), could be included in the model. This increased the likelihood of identifying what Groves calls the Z-variable (predictor) of response propensity and variable of interest (Groves 2006:650-52). Second, information was available for both respondents and non-respondents through the ESS main survey and non-response survey. Third, we study whether adjustments have an effect on correlations between relevant variables and on regression parameters of substantive explanatory models. Existing research often compares adjusted survey estimates with unadjusted ones. Some studies compare weighted and unweighted survey responses for selected variables (Lee 2006; Loosveldt and Sonck 2008; Schonlau et al. 2007). Other studies compare the variance of adjusted estimates with the mean squared error of the standard estimate (Duncan and Stasny 2001).

The next section presents the European Social Survey (ESS – 2006/2007) non-response survey and the method of analysis. This is followed by a section on results illustrating the differences between (ESS) non-respondents who provide additional information in a non-response survey and (ESS) cooperative respondents. In subsequent sections, the propensity score model is described and the effectiveness of propensity score weighting is evaluated in several ways. The paper

ends with some conclusions and with a discussion of avenues for future research.

2 Data and method

The ESS non-response survey (NRS) 2006-2007 was carried out in four countries – Belgium, Norway, Poland, and Switzerland – to assess whether (ESS) non-respondents who participated in the non-response survey differed from (ESS) cooperative respondents. In Belgium, the 'PEDAKSI' approach was taken in the form of DQS. In Norway, Poland and Switzerland, the 'basic question procedure' approach was taken. To compare the two kinds of surveys among non-respondents, Belgium and Norway were selected as case studies. Norway was selected because a longer questionnaire was used with several demographic and non-demographic items and its response rates were reasonable: lower than Switzerland but greater than Poland (Matsuo et al. 2009). The following section presents the sample design in these two countries in detail.

2.1 General design of the non-response study

1. *Target population and respondent selection procedure.* The target populations differed slightly in both countries. The Belgian DQS targeted all refusers. During the data collection, some initial refusers participated later on in the main survey. To gain a clear view of the differences between cooperative respondents and non-respondents, only DQS respondents who were also refusers in the ESS were included in the sample and analysis. The Norwegian NRS targeted all sample units: respondents as well as several types of non-respondents (refusers, non-contacts and other kinds of non-response units).

As a consequence of these differences in sample design, the sample selection also differed. In Belgium, the target group was selected at the door as the interviewers immediately proposed a short questionnaire when the selected person refused to participate in the main survey. In Norway, the target group comprised randomly selected ESS respondents, while the majority of ESS non-respondents were selected on the basis of their types of non-response. This means that hard refusers and people with language problems were not contacted.

2. *Data collection period and mode.* The Belgian DQS was conducted concurrently with the main survey.¹ The Norwegian NRS was implemented some months *after* the main survey.² In Belgium, the data collection mode was PAPI at the door as part of the main survey contact procedure. In Norway, after the main survey, an NRS questionnaire was mailed to non-respondents which was followed up with another mail after a couple of weeks which offered the additional possibility of completing the NRS questionnaire online (Web survey). After another couple of weeks, people who had not

¹ This took place between 23 October 2006 and 19 February 2007.

² The main survey took place between 21 August 2006 and 19 December 2006.

responded were contacted by CATI. No incentives were used in these two countries.

3. *Questionnaire design and types of questionnaire.* The key questions used in the DQS and the NRS were selected from the main survey on the basis of their expected sensitivity to non-response bias. Such information was available from other non-response bias studies carried out in previous rounds of ESS. These studies identified the questions with the largest differences in distribution between cooperative and reluctant respondents (Billiet et al. 2007) and the questions that were sensitive to variance inflation because of post-stratification weighting (Vehovar 2007).³

Two versions of the questionnaire were available: a short version (seven questions) was administered in Belgium and a longer version (fifteen questions) in Norway (see appendix). The key questions in the short version covered educational level, main occupation, household composition, participation in social activities, perception of neighbourhood security, interest in politics and attitudes towards surveys. Additional questions in the long version concerned year of birth, time spent watching TV, involvement in charity organizations, trust in people, trust in politicians, views on how democracy worked in the country, and views on immigration. In both versions of the questionnaire, the last question measured attitudes towards surveys. In both countries, information on age and gender was available for all sample units from the sample frame.

4. *Response rates.* The response rates to the DQS/NRS differed between the two countries (see Table 1). The response rate of the Belgian DQS among ESS refusers was 44.7 percent. In Norway, the response rates were much higher for ESS main survey respondents (60.8%) than for ESS main survey non-respondents (30.3%).

The rather high response rate for the Belgian DQS might be explained by the fact that the DQS was implemented together with the main survey. Sampled persons who refused were instantly offered the option of answering only seven questions instead of answering the full questionnaire. The NRS in Norway occurred several months after the main survey and the sample contained all types of ESS non-respondents.

2.2 Types of respondents and variables used in the analysis

We distinguished between two types of respondents: (ESS) cooperative respondents and (ESS) non-respondents. Cooperative respondents were those who participated in the ESS main survey, excluding the reluctant respondents (N=140 in Belgium and N=103 in Norway), which resulted in 1658 units in Belgium and 1646 units in Norway.⁴ Reluctant respondents were excluded because they differ significantly from cooperative respondents (Billiet et al. 2007). 'Non-respondents' were those who do not participate in the ESS main survey but did participate in DQS/NRS. Non-respondents participating neither in ESS main survey nor in

DQS/NRS were therefore not part of the analysis. The meaning of non-respondents included in the analysis differed for Belgium and Norway respectively. For Belgium, these were refusers (a sub-category of non-respondents, N=303) while for Norway, these included all types of non-respondents (N=242) (Table 2). In the database, there were complete records for cooperative respondents (all variables from the main survey) and partial records for non-respondents (restricted number of variables from DQS/NRS).

In the analysis, some variables (age; educational level; work status and household composition) were coded. Respondents' age was coded into six age categories (14-29; 30-39; 40-49; 50-59 and 60 plus).⁵ Occupation was coded into two categories: employed and unemployed. Household composition was coded into two categories: one-person household and multi-person household. Educational level was coded differently in each country. Because both countries have specific national education systems which consist of different levels, the Belgian national education system was coded into 4 levels while the Norwegian education system was coded into 3 levels.⁶

With regard to attitudinal variables, for ease of presentation, only the mean value was given rather than the distributions per variable in Table 3. For the Norwegian NRS, since no substantial differences were found for mode by type of respondent, the gross sample of 3 modes⁷ was analyzed.

2.3 Analysis

The analysis of non-response bias, defined as the deviation between cooperative respondents and non-respondents, and the adjustment of the ESS sample consist of five stages. In the first stage, the response distributions for all variables

³ For ESS Round 1, Vehovar (2007) showed that within surveys, some variables, such as attitudes towards immigration or political interest, are more sensitive to bias than others and are marked by higher (absolute) average standardised bias.

⁴ The NRS survey in Norway also comprised 230 (fully) cooperating respondents who participated a second time in the NRS. Repeated measurements are available for these respondents and they were also analyzed. As to be expected from questions soliciting opinions, the answers are not completely stable (Saris and Sniderman, 2004) and the distributions of all main survey (fully) cooperating respondents and the NRS respondents are different. We choose to compare the non-respondents with the (fully) cooperating respondents in the main survey since the sample is much larger and since it is the aim of this research to adjust the main sample for non-response bias. Full information about all NRS respondents ((fully) cooperating respondents and non-respondents) is reported in Matsuo et al. 2009.

⁵ In both countries, age is recorded in the sample frame.

⁶ In Norway, it was decided to merge lower basic and lower secondary educational level because of mode effects. In the data collection, while some respondents ticked primary education in the postal mail NRS, the 'correct' category is ascertained in the main ESS interview where the interviewer helped respondents to answer correctly.

⁷ NRS in Norway consists of 3 modes: mail (85%); Web (2.89%) and CATI (12.40%).

Table 1: Sample design in non-respondent survey in Belgium and Norway

	Target group	Duration	Mode	Incentives	Type of questionnaire	Response rates
BE	Refusers of main survey (n=694)	Same period as in main survey (23 October 2006 and 19 February 2007)	PAPI at the door	No	1 type: Short	44.7% (n=303/694)
NO	Both respondents (n=403) and non-respondents (n=800)	After the main survey (30 March and 01 August 2007).	Mail/Web/CATI	No	1 type: Long	Respondents: 60.79% (n=245/403) Non-respondents: 30.25% (n=242/800)

Table 2: Type of respondents in ESS main survey and non-respondent survey in Belgium and Norway

	Total	ESS					DQS/NRS	
		Respondents	Refusal	Non-contact	Other	Ineligible	Respondents	Non-respondents
BE	3249	1798 (61.01%)	710 (24.09%)	85 (2.88%)	354 (12.01%)	302 (9.3%)	n.a.	303
NO	2750	1749 (64.35%)	703 (25.86%)	21 (0.77%)	245 (9.01%)	32 (1.2%)	245	242

a. Emphasized figures show the target group of NRS/DQS in both countries. Percentage in ESS is calculated on the basis of eligible sample units. Percentage of ineligible units is calculated on the basis of total sample units.

b. Of 1798 Belgian respondents, 1658 were cooperative respondents and 140 reluctant respondents. Of 1749 Norwegian respondents, 1646 were cooperative respondents and 103 reluctant respondents.

are compared between non-respondents (refusals) and cooperative respondents using test statistics (X^2 or differences between means t -test) in each country. Variables that show substantial differences by type of respondent are retained for further analysis.

In the second stage, the effects of predictor variables – those identified as being substantially different (0.05 α -level) in the first stage – on response propensities are estimated (Lee and Valliant 2008:178-79). All possible predictors identified in the first stage are used in the model unless they are clearly unrelated to the treatment outcomes for the model (Rubin and Thomas 1996). This means that the model for each country includes different variables. In order to estimate the effects of the predictors, the odds ratios of being a cooperative respondent versus a non-respondent are estimated by means of logistic regression models by introducing a notation for the set of variables identified at the first stage.

In the third stage, propensity scores are modelled as follows:

$$\log[p/(1-p)] = \alpha + \beta' f(x)$$

where $f(x)$ is some function of covariates (Lee and Valliant 2008). These scores express the probability of survey response taking a value between 0 and 1 (a higher value points to a higher probability of being a cooperative respondent) and are calculated on the basis of the model identified in stage 2. Propensity scores can be modelled by different parametric models but here the most basic one – logistic regression model – is used (see discussion in D'Agostino 1998, Lee and Valliant 2008).

Propensity score adjustment can be done in different ways (Rosenbaum and Rubin 1983; Rosenbaum and Rubin 1984) but here we apply the 'sub-classification method' or the so-called 'stratification' method. A common technique of stratification proposed by Little and Rubin (2002) is to divide the sample into groups that have the *same number of units* (Cochran 1965 and 1968; Rosenbaum and Rubin 1984). It is not obvious how to choose the number of strata. Some (Cochran 1968; Rosenbaum and Rubin 1984) suggest five strata, whereas others (Smith et al. 2001; Little and Vartiarian 2003) suggest that the number of strata be determined statistically. In this study, based on other empirical studies focusing on Web surveys (Schonlau et al. 2006; Loosveldt and Sonck 2008), we chose 10 strata.⁸ The distribution of deciles is a reflection of the sample that contains information on both cooperative respondents and non-respondents based on the observed covariates.

In the fourth stage, propensity scores are transformed into weights through the following three steps:

- (1) The sample units with propensity scores are classified into 10 groups.
- (2) To transform propensity scores into weights, we use an approach similar to the one applied by Lee (2006), Loosveldt and Sonck (2008) and Lee and Valliant

⁸ We performed a small test using 15, 20, 50 and 100 strata and comparing the results with our initial approach (10 strata). A number of strata higher than 10 did not significantly improve the results. In addition, increasing the number of strata reduced the number of subjects per stratum which negatively affects the basis for weighting. We therefore opted for maintaining 10 strata in accordance with other studies (Schonlau et al. 2006; Loosveldt and Sonck 2008).

(2009): we calculate weights where the distributions for cooperative respondents are similar to those of the *combined sample* (cooperative respondents and non-respondents). Following established approaches (Lee 2006; Lee and Valliant 2009), let us first define S^R as the sample of cooperative respondents and S^{NR} as the sample of non-respondents. The total sample is $S^R + S^{NR}$. The distribution of the (cooperative) respondent sample is rearranged so that S^R resembled the distribution of $S^R + S^{NR}$. Every unit in the sample is assigned to the corresponding stratum. In the c th stratum in the total sample, there are $n_c = n_c^{NR} + n_c^R$ units included, where n_c^{NR} is the number of non-respondents and n_c^R is the number of cooperative respondents in the corresponding c th stratum sample. The total number of units in the sample remains the same:

$$\sum_{c=1}^C (n_c^{NR} + n_c^R) = \sum_{c=1}^C n_c = n$$

Because design weights are equal to 1 for all units in both Belgium and Norway,⁹ the weights in the c th stratum are:

$$W_c^R = \frac{(n_c^{NR} + n_c^R)/(n^{NR} + n^R)}{n_c^R/n^R}$$

Here n^{NR} represents the total number of units of non-respondents in all strata and n^R the total number of units of cooperative respondents in all strata. When weights for non-respondent W_c^{NR} in the c th stratum are calculated, denominators are simply replaced with n_c^{NR}/n^{NR} .¹⁰

- (3) Units without propensity scores (those that have at least one missing value in one of the variables in the model) are assigned '1' as their weights so that all sample units are assigned weights (values).

In the fifth and final stage, the results of the adjusted data are evaluated by two approaches. Under the first approach, it is assessed whether there are substantial differences between the responses of the cooperative respondents before and after applying propensity score weighting. The response distributions of the observed frequencies in the unweighted sample are tested against the *expected* frequencies that are observed in the weighted sample. Large differences in both distributions reflected in test statistics (lower X^2 -values, t -values and p -values) show that weights are effective.

To evaluate the effectiveness of propensity score weighting, we also test a substantive explanatory model for variables that are sensitive to non-response bias (the acceptance of immigrants in the country and interest in politics) in the weighted and unweighted samples. The reason for this additional test is that social scientists are less interested in marginal distributions than in the parameters in models where target variables are explained by theoretically relevant predictors. The question is whether *adjustment for non-response bias by propensity score weighting, as is used here, affects parameter estimates and substantive conclusions in theoretical relevant explanatory models.*

The second approach examines whether the differences between the distributions of respondents and non-respondents are reduced substantially by applying the weights based on the propensity scores. If that is the case, then differences between cooperative respondents and non-respondents that *exist before weighting* disappear after weighting.

3 Results

3.1 Comparing response distributions: cooperative respondents vs. non-respondents

Table 3 compares response distributions between cooperative respondents and non-respondents in ESS and DQS/NRS. Large differences are found for a number of variables in both countries. In Belgium, these concern the questions on age, educational level, participation in social activities, and political interest. Non-respondents (refusers only who participated in DQS) are more likely to be in the age categories 30-39 years and 60 plus, somewhat lower educated, living alone, less interested in participating in social activities, and less interested in politics.

In Norway, most variables show substantial differences between respondents and non-respondents. Exceptions are age, gender, household composition, and perception of neighbourhood security. Among the Norwegian non-respondents, the proportion that obtained only lower or basic education is higher and the proportion that obtained higher education is lower as compared to cooperative respondents. Non-respondents are also more likely to be unemployed and living alone. As for attitudinal variables, non-respondents are more likely to be less satisfied with the way democracy works than cooperative respondents. Non-respondents also have lower trust in people and politicians, watch TV longer, and are less involved in charity work than cooperative respondents.

3.2 Predicting response propensity: cooperative respondents vs. non-respondents

In the second stage, the propensity model is fitted. Tables 4 and 5 show the odds ratios resulting from the logistic regression model comparing cooperative respondents in relation to non-respondents in Belgium and Norway. Predictors in each model are selected on the basis of Table 3 and are country-specific. They are variables for which large differences by type of respondent are observed through test statistics (either X^2 or t -test) in both countries. In the logistic regression model, some predictors do not have a significant effect on the dependent variable, but are included in the estimation of the propensity score model as suggested by the literature (Lee and Valliant 2008).

⁹ Where the sampling design is concerned, two-stage probability sampling in Belgium and one-stage systematic random sampling in Norway were used (NSD, 2006).

¹⁰ Weights for non-respondents are used for the second approach.

Table 3: Responses to key questions in the doorstep question survey (DQS) in Belgium and non-response survey (NRS) in Norway by types of respondent

	Belgium		Norway	
	Coop res. (n=1658)	Non-respondents (Refuser) (n=303)	Coop res. (n=1646)	Non-respondents (n=242)
Age				
14-29	23.40	8.25	22.24	17.77
30-39	16.04	21.45	17.25	14.05
40-49	20.69	16.83	21.26	21.07
50-59	16.22	18.81	17.07	19.83
60+	23.64	34.65	22.17	27.27
	$\chi^2=47.544; df=4; p < 0.0001$		$\chi^2=7.534; df=4; p=0.110$	
Gender				
Male	46.68	47.52	51.64	46.28
Female	53.32	52.48	48.36	53.72
	$\chi^2=0.073; df=1; p=0.787$		$\chi^2=2.783; df=1; p=0.095$	
Educational level				
Lower (basic)	25.41	33.92		
Lower secondary (hum.)	10.56	9.19	17.77	34.30
Higher secondary (tech.&hum) &	35.67	33.22	35.61	34.71
Higher Tertiary	28.36	23.67	46.62	30.99
	$\chi^2=9.349; df=3; p=0.025$		$\chi^2=49.920; df=3; p < 0.0001$	
Work status				
Employed	49.76	50.35	67.60	56.43
Unemployed	50.24	49.65	32.40	43.57
	$\chi^2=0.034; df=1; p=0.853$		$\chi^2=13.728; df=1; p=0.0002$	
Household composition				
One-person household	11.59	15.57	19.10	19.50
Multi-person household	88.41	84.43	80.90	80.50
	$\chi^2=3.651; df=1; p=0.056$		$\chi^2=0.025; df=1; p=0.874$	
Neighborhood security ¹				
Very safe	19.84	18.18	50.91	45.00
Safe	60.07	61.89	40.83	44.17
Unsafe	17.06	16.78	6.01	8.33
Very unsafe	3.02	3.15	2.25	2.50
	$\chi^2=0.499; df=3; p=0.919$		$\chi^2=4.517; df=3; p=0.211$	
Participation in social activities				
Much less than most	15.30	27.27	3.28	12.45
Less than most	29.20	24.36	17.69	17.43
About the same	35.25	37.09	61.16	60.17
More than most	15.90	6.55	16.05	8.30
Much more than most	4.35	4.73	1.82	1.66
	$\chi^2=36.295; df=4; p < 0.0001$		$\chi^2=70.776; df=4; p < 0.0001$	
Political interest				
Very interested	8.75	4.55	9.72	3.32
Quite interested	37.15	19.58	39.00	31.12
Hardly interested	33.17	31.12	44.29	50.21
Not at all interested	20.93	44.76	6.99	15.35
	$\chi^2=84.070; df=3; p < 0.0001$		$\chi^2=40.047; df=3; p < 0.0001$	

¹Feeling of safety when walking alone in local area after dark.

Table 3: Continued

	Belgium		Norway	
	Coop res. (n=1658)	Non-respondents (Refuser) (n=303)	Coop res. (n=1646)	Non-respondents (n=242)
Satisfaction with democracy (0: dissatisfied – 10: satisfied) Means/SD	n.a.	n.a.	6.632/1.941 <i>t</i> =5.31; <i>df</i> =1864; <i>p</i> <.0001	5.907/2.119
Trust in politicians (0: No trust – 10: complete trust) Means/SD	n.a.	n.a.	4.457/1.997 <i>t</i> =1.40; <i>df</i> =1876; <i>p</i> =0.162	4.261/2.226
Imm. make country worse/better place to live in (0: worse – 10: better) Means/SD	n.a.	n.a.	5.117/2.040 <i>t</i> =5.17; <i>df</i> =1871; <i>p</i> <.0001	4.356/2.558
Daily TV viewing (0: No time – 7: more than 3 h.) Means/SD	n.a.	n.a.	3.709/1.764 <i>t</i> =-4.38; <i>df</i> =1878; <i>p</i> <.0001	4.248/1.750
Involved in work for vol. and charity org. (0: at least once a week - 6: never) Means/SD	n.a.	n.a.	4.211/1.735 <i>t</i> =-2.69; <i>df</i> =1885; <i>p</i> =.0007	4.531/1.625
Trust in most people trusted/ can't be too careful (0: can't be too careful – 10: most trusted) Means/SD	n.a.	n.a.	6.844/1.805 <i>t</i> =1.89; <i>df</i> =1884; <i>p</i> =0.058	6.600/2.250

a. (BE) χ^2 is computed for partial cross-tables between types of respondent: cooperative respondent vs. nonrespondent (refuser);

b. (NO) χ^2 refers to survey response distributions (expected distribution) between types of respondent: cooperative respondent vs. non-respondent; t-value is compared between types of respondent (cooperative respondent vs. nonrespondent); and

c. Educational level is categorised differently in Belgium and Norway. For an explanation, consult the text.

As expected, following the test statistics in Table 3, the results in Table 4 show that in the case of Belgium, cooperative respondents are less likely to be aged 30-39 years (odds ratio: 0.613) or 60 and above (odds ratio: 0.639) than to be aged 14-29 years. They also participate more than others in social activities (odds ratio: 1.448) and are more likely to be interested in politics (odds ratio: 0.643 in 'less interested in politics' compared to 'very/quite interested in politics').¹¹

The model for Norway is constructed in several steps.¹¹ First all potential predictors are identified by applying the same procedure as for Belgium. First, educational level and work status correlate rather strongly and it is decided to retain only the educational level to avoid any multicollinearity. Based on a thorough exploration of the model specification, a numeric scale is used for educational status. The final selection of variables is shown in Table 5. In comparison with non-respondents, cooperative respondents are more likely to be: highly educated, much more active in social activities,

satisfied with the way democracy worked in the country, and positive about immigration.

3.3 Evaluation of the impact of propensity score weighting

On the basis of the key predictors included in the propensity model (see Tables 4 and 5), we assess the use of weights to adjust bias through two approaches. As already mentioned, the first approach involves examining whether there are significant differences between the responses of cooperative respondents before and after weighting. Unweighted and weighted results are compared for other questions in the main survey, not just for the key questions. Additional

¹¹ For Norway, we also assessed the feasibility of including mode, but distributions for this variable did not differ significantly between respondents and non-respondents and inclusion in the bias adjustment model did not produce significant results.

Table 4: Logistic regression of the odds ratios of cooperating (n=1653) as compared to not cooperating in surveys (n=266) in Belgium

	Odds ratios	SE
Age		
30-39	0.613**	0.134
40-49	1.071	0.147
50-59	0.843	0.148
60+	0.639**	0.120
<i>Ref: 14-29</i>		
Educational level		
Lower secondary	1.151	0.179
Higher secondary	0.999	0.114
Higher tertiary	1.161	0.126
<i>Ref: Lower basic educ.</i>		
Participation in social activities		
Almost the same	0.794*	0.106
More than most/much more than most	1.448**	0.142
<i>Ref: much less than most/less than most</i>		
Political interest		
Hardly/not at all interested	0.643***	0.078
<i>Ref: very/quite interested</i>		

*** p-value<.0001; ** p-value<.01; * p < .05;

Hosmer and Lemeshow =20.436; R²=0.057;

Table 5: Logistic regression of the odds ratios of cooperating (n=1616) as compared to not cooperating in surveys (n=225) in Norway

	Odds ratios	SE
Education level (numeric: 0-8)	1.175**	0.045
Participation in social activities		
Less than most	1.207	0.156
About the same	1.128	0.118
Much more than most	1.922**	0.194
<i>Ref: much less than most</i>		
Involved in charity organisation (numeric: 0-6: at least once a week – never)	1.004	0.047
Daily TV viewing time (numeric: 0-7: no time – 3+ hrs per day)	0.933	0.042
Political interest		
Hardly interested	1.069	0.107
Not at all interested	0.749	0.154
<i>Ref: very & quite interested</i>		
Satisfaction with how democracy works (numeric 0-10: dissatisfied – satisfied)	1.092*	0.037
Immig. make country worse/better place to live in (0-10: worse place – better place)	1.091*	0.036

Note: *** p-value<.0001; ** p-value<.01; * p < .05;

Hosmer and Lemeshow = 9.162; R²=0.052;

tests are done by investigating the effect of propensity score weighting on the parameters in the substantive explanatory model in which the variance of variables that are sensitive to non-response bias is explained. Under the second approach, the response distributions according to kind of respondent (cooperative respondent vs. non-respondent) are compared between the weighted and unweighted samples. The weighting procedure is considered successful when the pre-weighting differences between cooperative respondents and non-respondents disappear after weighting. This means that after the weighting procedure, samples of cooperative respondents and non-respondents are balanced according to the key variables studied since there are no longer systematic differences between cooperative respondents and non-respondents.

Applying the first approach, it is found that in the case of Belgium, none of the variables included in the key and main questionnaires show significant differences (results not shown in the table). This means that using information from non-respondents (refusers) collected in DQS has little impact on the original sample (cooperative respondents). In Norway as well, none of the variables in the key and main questionnaires shows adjustment effects, although for some variables such as educational level, a lower p -value is observed ($X^2=3.866$; $p=0.145$).

In the preceding, there are no differences in univariate distributions that were observed between weighted and unweighted samples. Because we are interested in the parameters in models where target variables are explained by theoretically relevant predictors, the question here is to investigate whether there are any effects of weighting on the estimated regression parameters in the explanatory models. Because the model for propensity score weighting includes a number of key variables and some indication of adjustment is found in Norway, we use the data from Norway. Two regression models are tested for the variables “*acceptance of immigrants*” and “*trust in politics*”. The first variable is measured by three indicators (“trust in country’s parliament”, “trust in the legal system”, “trust in the police”, “trust in politicians”) dealing with conditions for accepting immigrants into the country (Cronbach $\alpha = 0.85$). None of these indicators is used in the propensity score estimates. The second variable consists of four indicators: “allow many/few immigrants of same race/ethnic group as majority”; “allow many/few immigrants of different race/ethnic group as majority”; “allow many/few immigrants from poorer countries outside Europe” and “measuring trust in political institutions” (Cronbach $\alpha = 0.80$). One of these indicators is in the NRS questionnaire but is not used in the logistic model of the propensity score estimates.

The explanatory variables in the model of “*acceptance of immigrants*” are age, urbanity, education, watching TV, control over one’s job, involvement in voluntary organisations, the dependent (explained) variables are interest in politics, trust in politics, social trust, and two value orientations (conservation and self-transcendence). These variables are selected on the basis of substantive empirical studies on this issue using ESS Round 2 data (Davidov et al. 2008) in which

equivalent measurement models for these attitudinal (latent) variables were tested using Multi Group Structural Equation modelling (MGSEM) using identical indicators as in Round 3. The predictors for “*trust in politics*” are largely the same (Abts 2007). In the actual analysis, composite scales were made on the basis of adequate indicators for each concept.

Nearly all predictors contribute significantly to the variance of the explained variables, and borderline predictors remain not significant after weighting. The explained variance in the dependent variables is respectively 16% for “*acceptance of immigrants*” and 22% for “*trust in politics*” in both samples, weighted and unweighted. Almost no differences in the estimated parameters are found. The largest difference in standardised parameters is found for the predictor “control over job” between the unweighted ($\beta=0.028$; $p=0.272$) and weighted ($\beta=0.043$; $p=0.082$) samples, but the parameters remain not significant at the 0.05 level. In other words, adjustment of the sample does not lead to any change in conclusions about relationships between explanatory and explained variables after adjustment for non-response bias with the method that is used.

In the second approach, we found that in the case of Belgium, as presented in Table 6, weighting makes a difference for variables such as age and educational level, but not for participation in social activities and political interest. This means that differences between cooperative respondents and non-respondents (refusers) that are present before propensity score weighting have disappeared with the exception of two non-demographic variables. In the case of Norway, it is possible to test the effectiveness of weights for a larger number of variables because the two surveys (ESS and NRS) have many socio-demographic and non-demographic (attitudinal and behavioural) variables in common. Table 6 shows that weights make differences for most demographic and non-demographic variables. An exception is the variable political interest since for this variable the p -value remained large even after adjustments. However, by and large, our results indicate that, after weighting, the samples of respondents and non-respondents are balanced according to the variables studied and that systematic differences between cooperative respondents and non-respondents have been eradicated.

4 Conclusion and discussion

In this paper, we examined whether the systematic differences between cooperative respondents and non-respondents can be removed on the basis of information obtained from ESS non-response surveys carried out in two countries, Belgium and Norway. Two approaches are discussed: doorstep questions survey (DQS) (refusals were asked to answer a few questions after they had refused to participate in the main survey) and non-response survey (NRS) (both respondents and non-respondents of the main survey were asked to participate some months after the data collection). Both used either a short or a long key questionnaire.

Both types of surveys used in this study (DQS/NRS) have their respective advantages and disadvantages. The Norwegian NRS, while more costly, time-consuming, and

Table 6: Statistical test information about the differences between unweighted and weighted distributions on key questions between cooperative respondents and refusers (Belgium) and non-respondents (Norway)

	Belgium			
	Unweighted		Weighted	
	χ^2	prob.	χ^2	prob.
Age categories ($df=4$)	47.544	<0.0001	3.321	0.506
Educational level ($df=3$)	9.349	0.025	6.535	0.088
Participation in social activities ($df=4$)	36.295	<0.0001	18.811	0.0009
Political interest ($df=3$)	84.070	<0.0001	18.433	0.0004
	Norway			
	Unweighted		Weighted	
	χ^2	prob.	χ^2	prob.
Education level ($df=2$)	40.552	<0.0001	1.813	0.404
Work status ($df=1$)	11.594	0.0007	0.470	0.493
Political interest ($df=3$)	33.014	<0.0001	13.247	0.010
Participation in social activities ($df=4$)	48.105	<0.0001	2.301	0.681
	t -value	prob.	t -value	prob.
Satisfaction with democracy ($df=1864$)	5.31	<0.0001	1.01	0.313
Imm. make country worse/better place ($df=1871$)	5.17	<0.0001	0.56	0.577
Daily TV viewing time ($df=1878$)	-4.38	<0.0001	-0.81	0.420
Involved in work for voluntary & charity org. ($df=1885$)	-2.69	0.007	-0.69	0.492

* Only key questions with substantial differences in distribution ($p < .05$) in unweighted sample (Table 3) are shown.

** χ^2 / t -tests in both countries are computed for partial cross-tables: cooperative respondent vs. non-respondent.

implemented at a different time and through a different mode than the main survey, was considered more useful than the Belgian DQS from the perspective of adjusting bias because it targeted a wider range of non-respondents and used a longer version of the questionnaire. The utility of a Belgian-style DQS, which is less expensive and less burdensome for respondents, interviewers, and survey organizations compared to NRS, could be enhanced by lengthening the questionnaire, broadening the target group, and increasing the number of variables directly recorded in the contact forms as part of the standard contact procedure. Such adjustments are feasible, reasonably cost-effective, and informative in a multi-national setting. In any case, these approaches are effective when the samples are sufficiently large and the response rate high. Otherwise the sample will comprise a selective group of non-respondents.

Our analysis of the adjustment of bias based on propensity score weighting was implemented in five stages. In the first stage, we confirmed the existence of non-response bias for variables identified in earlier ESS-related research as 'prime suspects' and included in both the Belgian DQS and the Norwegian NRS: educational level, participation in social activities, and political interest. In the following two stages, scores expressing the propensity of being a cooperative respondent were calculated on the basis of a logistic regression model. Predictors were country specific. For Belgium, they included age, educational level, social participation, and political interest. For Norway, where a longer questionnaire was used, they included a number of behavioural and attitudinal variables, such as views on how democracy works in

the country, views on immigration, involvement in charity organizations, and daily TV viewing habits. In the 4th stage, the propensity scores obtained in the previous stages were transformed into weights in three steps:

- (1) the scores were sorted and all units were stratified into deciles and corresponding stratum;
- (2) consistent with already established approaches, weights were calculated so that distributions for cooperative respondents were similar to those of the total sample (cooperative respondents and non-respondents);
- (3) units without propensity scores were assigned the value '1' so that all units were assigned to weights.

In the final stage, the procedure was evaluated based on two approaches:

- (1) comparing the responses and predictors in the explanatory model of cooperative respondents before weighting with those after weighting, and
- (2) comparing the response distributions according to kind of respondent (cooperative respondent vs. non-respondent) between the weighted and unweighted samples.

In the second approach, the propensity scoring procedure was considered successful when differences in the weighted distributions or means of all the covariates for respondents and non-respondents were reduced and balance was achieved. Propensity score weighting based on selected predictors in a logistic regression model had a reasonable impact. The adjustment of non-response bias on the basis of information from a DQS/NRS was mostly successful: weighting makes a difference for all demographic variables but less

for some non-demographic variables in both countries. An evaluation based on the first approach showed no significant differences between observed and expected frequencies for the samples of ESS cooperative respondents in both countries even though some variables such as education had a lower p -value. An extension of the first approach showed that the adjustment of the sample did not lead to any changes in conclusions about the relationship between the dependent variables and predictors. The reason why bias could not be adjusted may be that it was small to begin with. It may also be that compared to the cooperative respondent sample, the samples of non-respondents in DQS/NRS were too small.

Further research on the adjustment of non-response bias is required. A number of issues deserve further exploration. First, in our model, the dependent variable was the propensity of being a cooperative respondent. It is worthwhile to also explore the inclusion in these kinds of propensity score weighting analysis of other sample units – for instance, reluctant respondents or ‘other non-respondents’ (who did not participate in DQS/NRS). Second, other kinds of predictors, e.g. observable data, could be included (through, for instance, a calibration method) depending on the availability and reliability of such covariates.

Finally, the feasibility of further meaningful research is dependent on additional consolidated efforts as far as the planning, monitoring, and implementation of non-response surveys is concerned. If all countries participating in ESS were to carry out non-response surveys, the sample design (target group), questionnaire (including both demographic and non-demographic variables), timing, mode, and use of incentives should be standardised across countries.

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Appendix: Questionnaire

Types of questionnaires used in non-response survey

Basic non-response module questionnaire

Split ballot: survey climate – short version (1 sheet)

1. Which of these descriptions best describes your situation? Please select only one.

In paid work; In education; Unemployed; Doing housework, looking after children or other persons; Retired; Other

2. What is the highest level of education you have achieved? Please use the country-specific question and codes for coding into the ESS coding frame

No qualifications; CSE grade 2-5/GCSE grades D-G or equivalent; CSE grade 1/O-level/GCSE grades A-C or equivalent; A-level, AS-level or equivalent; Degree/postgraduate qualification or equivalent; Other

3. Including yourself, how many people – including children – live regularly as members of your household? ...

4. Compared to other people of your age, how often would you say you take part in social activities, i.e. you participate in the meetings with your friends or family members?

Much less than most; Less than most; About the same; More than most; Much more than most

5. How safe do – or would – you feel walking alone in your local area after dark?

Very safe; Safe; Unsafe; Very unsafe

6. How interested would you say you are in politics?

Very interested; Quite interested; Hardly interested; Not at all interested

7. Do you agree or disagree with the following statement: surveys are valuable for the whole society, as we all want to know what the [inhabitants of Country] think and what opinions they have on various important matters

Completely agree; Agree; Not agree, not disagree; Disagree; Completely disagree

Split ballot: survey climate – long version (2 sheets)

1. What is your gender?

Male; Female

2. In what year were you born? ...

3. What is the highest level of education you have achieved?

Please use the country-specific question and codes for coding into the ESS coding frame

No qualifications; CSE grade 2-5/GCSE grades D-G or equivalent; CSE grade 1/O-level/GCSE grades A-C or equivalent; A-level, AS-level or equivalent; Degree/postgraduate qualification or equivalent; Other

4. Which of these descriptions best describes your situation? Please select only one.

In paid work; In education; Unemployed; Doing housework, looking after children or other persons; Retired; Other

5. Including yourself, how many people – including children – live regularly as members of your household? ...

6. On an average weekday, how much time, in total, do you spend watching television?

No time at all; Less than ½ hour; ½ hour to 1 hour; More than 1 hour, up to 1 ½ hours More than 1 ½ hours, up to 2 hours; More than 2 hours, up to 2 ½ hours; More than 2 ½ hours, up to 3 hours; More than 3 hours

7. In the past 12 months, how often did you get involved in work for voluntary or charitable organisations?

- At least once a week; At least once a month; At least once every three months; At least once every six months; Less often; Never

8. Compared to other people of your age, how often would you say you take part in social activities, i.e. you participate in the meetings with your friends or family members?

- Much less than most; Less than most; About the same; More than most; Much more than most

9. How safe do – or would – you feel walking alone in your local area after dark?

- Very safe; Safe; Unsafe; Very unsafe

10. Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people? Please indicate your answer on a score of 0 to 10, where 0 means you can't be too careful and 10 means that most people can be trusted.

You can't be too careful												Most people can be trusted
0	1	2	3	4	5	6	7	8	9	10		10

11. How interested would you say you are in politics?

- Very interested; Quite interested; Hardly interested; Not at all interested

12. On the whole, how satisfied are you with the way democracy works in [country]? Please indicate your answer on a score of 0 to 10, where 0 means that you are extremely dissatisfied, and 10 means that you are extremely satisfied with the way democracy works in [country].

Extremely dissatisfied												Extremely satisfied
0	1	2	3	4	5	6	7	8	9	10		10

13. Please indicate on a score of 0-10 how much you personally trust politicians. 0 means you do not trust politicians, and 10 means you have complete trust in politicians

No trust at all												Complete trust
0	1	2	3	4	5	6	7	8	9	10		10

14. Is [country] made a worse or a better place to live by people coming to live here from other countries? 0 means that [country] is made a worse place to live and 10 means that [country] is made a better place to live by people coming to live here from other countries.

Worse place to live												Better place to live
0	1	2	3	4	5	6	7	8	9	10		10

15. Do you agree or disagree with the following statement: surveys are valuable for the whole society, as we all want to know what the [inhabitants of Country] think and what opinions they have on various important matters

- Completely agree; Agree; Not agree, not disagree; Disagree; Completely disagree