A Comparison of Early and Late Respondents in a Twin–Family Survey Study

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Differences between early (within 30 days) and late (after 30 days) respondents in a survey study were analyzed in twins and siblings registered with the Netherlands Twin Register. We compared early and late respondents on personality traits, health, lifestyle, and demographic variables. The odds of being a late respondent were significantly higher for men (OR 1.14), alcohol use on a daily/weekly basis (OR 1.20), having a relationship (OR 1.40), higher score on experience seeking scale (OR 1.02), and criticizing the questionnaire as too long (OR 1.27). The odds of being a late respondent were significantly lower for nontwin subjects (OR 0.71), regular cycling (OR 0.83), and judging the questionnaire to be fun (OR 0.80). There were no significant interactions with sex. To examine to what extent early and late response is influenced by genetic factors, twin and sibling data of 5040 subjects were analyzed. The best model includes genetic factors (31%), shared environmental influences (36%), and unique environmental influences (43%) on variation in response time.

Several studies have quantified bias due to non-response in survey studies. Differences between respondents and nonrespondents have been found in, for example, marital status, socioeconomic status, smoking behaviour, and alcohol consumption (Bergstrand et al., 1983; Etter & Perneger, 1997; Hill et al., 1997; van Loon et al., 2003; Vink et al., 2004).

In survey study research there often is only limited information on nonrespondents and the exact magnitude of the bias is difficult to assess. Methods to estimate the effect of nonresponse include comparisons to available data in population based registers, directly contacting nonrespondents by telephone or single-item reply cards, longitudinal repetition of the survey or estimation of nonresponse bias using data from participating family members (Vink et al., 2004). It has also been suggested that nonrespondents share some similarities with late respondents (Chen et al., 2003; Helasoja et al., 2002). A few studies have explored the differences between early and late respondents. In a Scottish survey study, no differences in personality or neuropsychological symptoms were found between early and late respondents. Delayed response tended to be related to current smoking, higher mean alcohol drinking, low socioeconomic status, low education, and poorer health status, but results did not reach a conventional statistical significance (Chen et al., 2003). In a Finnish study early respondents were more often current smokers and users of antidepressants than late respondents, but no differences in heavy alcohol use and depression were observed (Korkeila et al., 2001). In a Spanish study a higher proportion of smokers in male early respondents compared to male late respondents was reported (Rodes et al., 1990). A study including subjects from Estonia, Finland, Latvia, and Lithuania reported that late response was more common among men and was weakly related to age, education, and place of residence (Helasoja et al., 2002).

In the present study differences between early and late respondents are explored in a sample of twins and siblings who participated in a mailed survey study of personality, health, and lifestyle of the Netherlands Twin Register. First, we looked at the association between early/late response and a number of health, lifestyle, and personality variables in a group of subjects sampled independently ($n = 2795$). Secondly, we examined to what extent early and late response is influenced by genetic factors in the complete sample of twins and siblings ($n = 3861$ twins and 1179 siblings).

Method

Study Sample

This study is part of an ongoing twin family study on health-related behavior of the Netherlands Twin Register (Boomsma et al., 2002; Boomsma et al., 2006). For the present study, data from the 2000 survey were used (Vink et al., 2004). This fifth survey consisted of 18 pages and was mailed out in May 2000. In July 2000 a reminder was sent to the nonrespondents. In total, 6792 subjects completed the survey. Most subjects were invited to participate in

May 2000. Some subjects (*n* = 649) were registered after May 2000 or received the survey later and were excluded from this study. Date of completing the survey was missing for 392 subjects. Data on early/late response were available for 5104 subjects; 1841 men (mean age 29.4, *SD* 10.6) and 3263 women (mean age 29.9, *SD* 10.4). Subjects were classified as early (< = 30 days) or late respondents (> 30 days). The cut off point of 30 days was chosen because the number of returned questionnaires dropped noticeably after 3 to 4 weeks. This is similar to another study (Chen et al., 2003) that also defined early respondents as subjects who returned a survey within 4 weeks. Figure 1 shows that the number of subjects returning the questionnaire as a function of days reaches an asymptote after day 30. To explore the association between early/late response and health, lifestyle, and personality variables in a sample of independent subjects, we randomly selected one person per family, resulting in a dataset of 2795 subjects (977 men and 1818 women). For the genetic analyses we used the data of 3861 twins; 584 monozygotic males (MZM), 360 dizygotic males (DZD), 1294 MZ females (MZF), 722 DZ females (DZF), and 381 males and 507 females from DZ opposite-sex (DOS) pairs. Zygosity was unknown for 11 females and 2 males. In addition, data from 492 brothers and 687 sisters were included.

Variables

A. Health and Lifestyle

- *Ever smoked*: 'Did you ever smoke?' was recoded to ever smoked (yes) and never smoked (a few times to try, no).

- *Current smoking*: 'How often do you smoke now?' was recoded to nonsmokers (*never smoked*, *never smoked regularly*, *quitters*) versus current smokers (*I smoke once a week or less, I smoke more than once a week but not every day, I smoke daily*).

- *Ever used alcohol*: 'Have you ever drunk alcohol?' was recoded to ever used alcohol (*yes*) versus never used alcohol (*a few times to try, no*).

- *Cannabis use*: 'Ever use soft drugs (e.g., hash, marijuana)?' with answer categories *11 years or younger, 12–13 years, 14–15 years, 16–17 years, 18 years or older*, and *never* was recoded as *ever* versus *never*.

- *Sports participation*: 'Do you participate in sports regularly?' (*no, yes*)

- *Regular cycling*: 'Do you cycle regularly?' (*no, yes*).

- *Religious*: 'Are you an active member of a religious communion?' was recoded into religious (*yes, I am an active member* and *I am religious but not a member of a religious communion*) versus *not religious*.

- *Body mass index*: weight in kg/height in m².

- *Health*: 'How is, in general, your health?' was recoded to good/excellent health (*good, excellent*) versus poor/reasonable health (*poor, fair, reasonable*).

- *Having children*: 'Do you have children?' (*no, yes*, including both biological and/or nonbiological children).

- *Oldest child younger than 12 years*: (*no, yes*)

- *Having fulltime job*: 'What kind of a job do you have now?' was recoded to having a full-time job (*full-time paid job > 32 hours a week*) versus not (*part-time paid job, school pupil/student, unemployed, retired (early), housewife/house husband, disabled, other*)

- *Education*: high (*higher vocational college and university*) versus lower education (*intermediate vocational and intermediate/higher general education* and *lower general and vocational education* and *primary school only*).

- *Relationship/spouse*: 'Do you have a steady partner?' *(no, yes)*.

B. Personality

The subscales neuroticism, somatic anxiety, test attitude, and extraversion from the Amsterdamse Biografische Vragenlijst (ABV; Wilde, 1970), and the subscales anxious depression, withdrawn, somatic complaints, thought problems, attention problems, intrusive behavior, aggressive behavior, rule breaking behavior of the Young Adult Self Report (YASR; Achenbach, 1997) translated and validated for the Dutch population by Verhulst et al. (1997) were used.

C. Opinion About Questionnaire

At the end of the survey we asked: 'What did you think of this questionnaire?' Answer options were: *too personal, fun, too long, difficult, interesting, annoying, clear, boring*. Subjects were allowed to tick more than one box.

Statistical Analyses

Association Between Early/Late Response and Health, Lifestyle, and Personality Variables

Data from male and female early and late respondents were compared with a χ^2 test for categorical variables and with ANOVA for continuous traits using SPSS (2006). Before comparing the means with ANOVA, we tested whether early and late respondents had equal variances using Levene's test of homogeneity of variances. Significant variables ($p \leq .05$) and sex were entered simultaneously as predictor variables into a binary logistic regression analysis, using a backward conditional method. The dependent variable was early (0) versus late (1) response.

Twin/Sibling Correlations and Genetic Model Fitting

First a saturated model was fitted to the data to estimate twin and sibling correlations. Because the phenotype is dichotomous (early/late response) a liability model was used (Falconer & Mackay, 1996), which assumes that the dichotomous trait reflects an underlying (latent) liability with a normal distribution (with unit variance),

and a threshold that divides the sample into early and late respondents. The threshold is obtained from the prevalences and can be interpreted as a z value. Model fitting was performed in Mx (Neale et al., 1999). Constraining the thresholds across first- and second-born twins and across zygosities did not worsen the fit of the model. Tetrachoric correlations for early/late response were estimated for MZM, DZM, MZF, DZF, DOS, brothers, sisters, and opposite-sex siblings.

The MZ twin and DZ twin and sibling data were used to decompose the variance in early/late response liability into additive genetic (a^2), common environmental (c^2) and unique environmental (e^2) variance (Boomsma et al., 2002; Falconer & Mackay, 1996; Neale et al., 1999). Twin and siblings correlations were modelled as: $r = \alpha a^2 + \gamma c^2$, where α is 1 for MZ pairs and .5 for DZ and sibling pairs. The correlation γ between common environmental effects was 1 in MZ and DZ same-sex pairs and was allowed to be less than 1 for DOS twin pairs (γ-DOS), same-sex siblings (γ-SSsibs), and opposite-sex siblings (γ-OSsibs).

Using nested models, we tested whether the magnitude of the contribution of genes and environment was the same in males and females, and whether both genetic

and common environmental factors play a role in early/late response by consecutively constraining their contributions to zero. This test is based on the assumption that the test statistic follows a chi-square distribution under the null hypothesis, with the number of restricted parameters as degrees of freedom. However, the chi-square approximation can be poor when the parameter value is on the boundary of the parameter space under the null hypothesis (Visscher, 2006). Dominicus et al. (2006) showed that a mixture of χ^2 (0 df) and χ^2 (1 df), and not simply χ^2 (1 df) should be used when testing the AE model or CE model against the ACE model (Dominicus et al., 2006). Using this mixture of distributions corresponds to halving the p value of the χ^2 (1 df) distribution.

Results

Response was highest in the first weeks, 50% of all questionnaires were completed before the 12th day. A small peak was seen after sending a reminder (reminder was sent on day 42). A histogram of the number of subjects returning the questionnaire as a function of days is shown in Figure 1. We divided subjects in 2 categories: early respondents (≤ 30 days) and
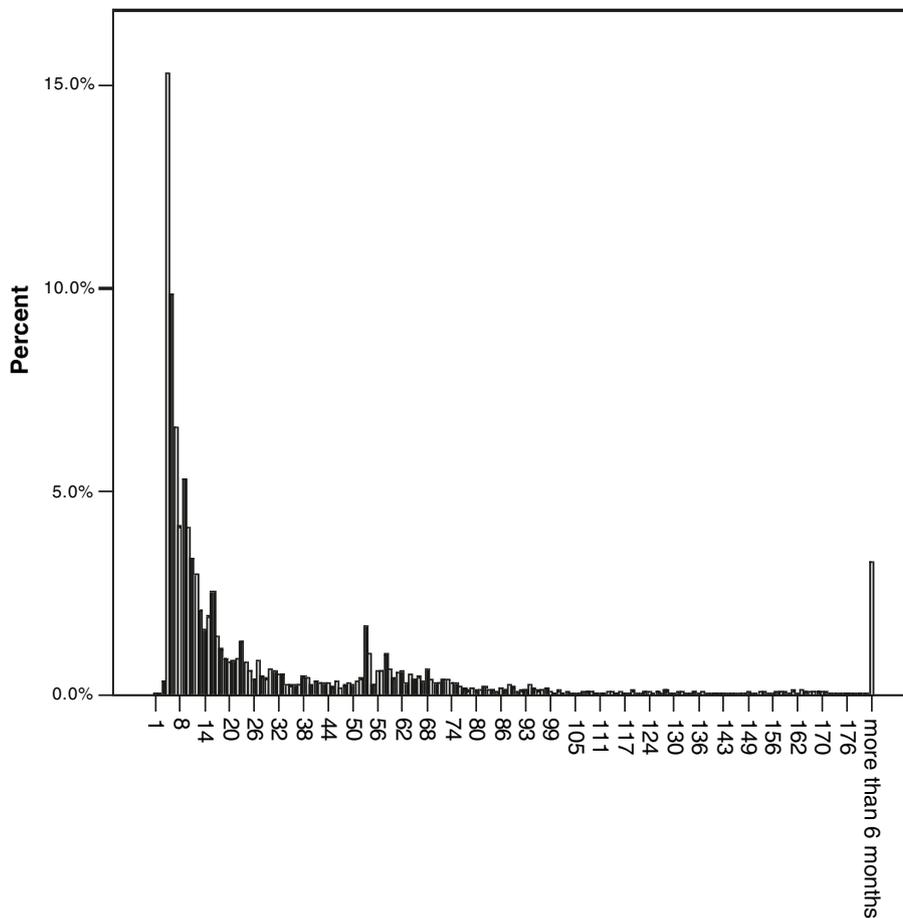

Figure 1

Frequencies of the number of days between receiving and completing survey 2000 of the Netherlands Twin Register. A reminder was sent on day 42. The last bar represents all subjects who returned the survey more than 180 days after it was sent.

Table 1

Differences in Health and Lifestyle Variables Between Early (≤ 30 days) and Late (> 30 days) Respondents in an Independent Sample (Random Selection of 1 Person Per Family, $n = 2795$)

	Males			Females		
	Early	Late	*p* value	Early	Late	*p* value
% ever smoked	34.7%	30.2%	.369	37.4%	38.3%	.820
% current smoker	30.3%	26.2%	.173	24.9%	25.6%	.745
% ever used alcohol	94.4%	94.7%	.848	87.1%	89.8%	.111
% alcohol weekly/daily	72.7%	79.0%	.029*	43.7%	48.3%	.078
% ever used cannabis	31.8%	33.2%	.661	23.6%	27.6%	.073
% regular sports	60.4%	59.4%	.760	58.3%	57.5%	.753
% cycling regularly	60.2%	51.8%	.011*	65.2%	64.4%	.745
% religious (active + not active)	47.6%	46.6%	.773	57.3%	53.5%	.143
Mean BMI	23.29	23.52	.324	22.68	22.44	.191
% good/excellent health	93.1%	94.0%	.567	89.3%	88.6%	.657
% having children	22.3%	22.8%	.858	30.4%	31.6%	.613
% oldest child ≤ 12 years	11.9%	11.6%	.899	17.9%	20.6%	.173
% having fulltime job	61.2%	67.8%	.043*	36.8%	38.2%	.573
% high education	38.2%	44.9%	.051	33.4%	37.8%	.084
% relationship/spouse	60.4%	65.2%	.145	69.8%	77.7%	.001*
% being a twin	75.8%	77.1%	.646	79.1%	85.0%	.004*

Note: *p ≤ .05

late respondents (> 30 days). Of the males, 68% were early respondents, while 73% of the females responded within 30 days. The mean age of the sample was 29.6 years (SD 10.0) and no age differences were found for early or late response (respectively 29.4 years, *SD* 10.1 and 29.8 years, *SD* 9.4, *F* = 1.24, *p* = .265).

Association Between Early/Late Response and Health, Lifestyle, and Personality Variables

Associations between early/late response and health, lifestyle, and personality variables were first explored in male and female subjects separately. Tables 1, 2 and 3 show the similarities and differences for early and late respondents in: health and lifestyle variables, personality scores, and opinion on the questionnaire, respectively. For the continuous traits, Levene's test of homogeneity of variances showed that the variances in early and late respondents did not differ, except for somatic anxiety in females (variance 28.5 in early respondents, 34.4 in late respondents, Levene's statistic *F* = 5.643, *p* = .018). All variables with significance level *p* ≤ .05 in the univariate analyses were selected for logistic regression analyses to investigate which factors are significantly associated with early/late response. The selected variables were: alcohol use, regular cycling, a high education, having a fulltime job, having a relationship/spouse, being a twin, judging questionnaire too personal, judging questionnaire fun, and judging questionnaire too long.

Next, a binary logistic regression analysis was carried out for the 11 significant variables simultaneously. Sex was first entered in the model. The other 11 variables were analyzed using the Backward Conditional Method. The model included interaction terms between the 11 variables and sex. Table 4 shows the odds ratios (OR) for the full model and for the best model (only including the variables that remained in the model after Backward Conditional Method). The odds of being a late respondent were significantly higher for males (OR 1.14) than for females. Furthermore, the odds of being a late respondent were significantly higher in subjects who used alcohol on a daily/weekly basis (OR 1.20), subjects who were involved in a relationship (OR 1.40), subjects who scored high on the experience seeking scale (OR 1.02), and subjects who criticized the questionnaire as too long (OR 1.27). In contrast, the odds of being a late respondent were lower for subjects who cycle regularly (OR 0.83), subjects who judged the questionnaire to be fun (OR 0.80), and for nontwin subjects (OR 0.71). There were no significant interactions with sex.

Twin/Sibling Correlations and Genetic Model Fitting

The MZ and DZ twin correlations for early and late response are summarized in Table 5. The correlations are somewhat higher for MZ than for DZ twins and siblings, but the correlation for DZ same-sex twins are noticeably higher than for DOS-twins/nontwin siblings, suggesting that shared environment is more important in same-sex twins than in opposite-sex pairs or in nontwin siblings. Model fitting results show that constraining the correlation for the shared environmental influences for DOS twins and nontwin siblings to be 1, significantly worsens the fit of the model (model 2). Constraining A, C, and E to be equal for

Table 2

Mean Score for Personality Traits in an Independent Sample of Early (< 30 Days) and Late (> 30 days) Respondents (Random Selection of 1 Person Per Family, *n* = 2795)

	Males			Females		
	Early	Late	*p*	Early	Late	*p*
Anxious depression (YASR)	4.1	4.1	.810	6.1	6.1	.910
Withdrawn (YASR)	2.6	2.6	.970	2.8	2.6	.135
Somatic complaints (YASR)	2.1	2.2	.340	3.5	3.4	.270
Thought problems (YASR)	.56	.49	.415	.50	.51	.938
Attention problems (YASR)	3.9	4.0	.522	4.4	4.4	.710
Intrusive (YASR)	2.7	2.7	.661	2.8	2.7	.247
Aggressive behavior (YASR)	5.7	5.7	.804	5.8	5.7	.706
Rule breaking behavior (YASR)	2.4	2.5	.582	1.6	1.5	.483
Neuroticism (ABV)	42.2	42.3	.979	51.3	52.2	.514
Somatic anxiety (ABV)	16.6	16.8	.545	18.4	18.6	.458
Test attitude (ABV)	37.5	36.1	.015 *	37.6	37.7	.751
Extraversion (ABV)	62.1	63.7	.158	60.9	61.5	.431
Thrill and adventure seeking (SBL)	38.5	39.0	.414	32.4	32.5	.723
Experience seeking (SBL)	34.7	35.5	.129	31.8	32.9	.008 *
Boredom susceptibility (SBL)	36.3	37.2	.054	34.9	35.7	.037 *
Disinhibition (SBL)	34.4	34.8	.505	28.2	28.6	.329
Total score (SBL)	11.3	11.5	.101	10.0	10.2	.057

Note: **p* ≤ .05

YASR = Young Adult Self Report (Achenbach, 1997; Verhulst et al., 1997), ABV = Amsterdamse Biografische Vragenlijst (Wilde, 1970), SBL = sensation seeking list (Zuckerman, 1971). Bonferoni correction *p* value: .05/17 = .003.

Table 3

Opinion on the Questionnaire in Independent Sample of Early and Late Respondents (Random Selection of 1 Person Per Family, *n* = 2795)

	Males			Females		
% 'yes'	Early	Late	*p* value	Early	Late	*p* value
Too personal	7.3%	6.6%	.680	5.9%	9.6%	.005 *
Interesting	40.7%	41.0%	.935	38.9%	36.9%	.411
Fun	26.1%	23.7%	.400	40.7%	32.1%	.001 *
Annoying	4.4%	6.0%	.276	2.6%	4.2%	.087
Too long	44.5%	49.7%	.123	35.4%	42.3%	.006 *
Clear	32.1%	28.4%	.238	29.9%	25.9%	.085
Difficult	5.0%	3.9%	.425	10.1%	9.3%	.583
Boring	8.6%	5.4%	.072	3.5%	5.3%	.457
At least 1 positive[a]	70.6	66.5	.087	75.3	69.9	.002 *
At least 1 negative[b]	51.8	54.2	.341	46.6	52.8	.002 *

Note: The percentage early and late respondents who judged questionnaire to be 'Too personal', 'Interesting' , 'Fun' , 'Annoying' , 'Too long', 'Clear', 'Difficult' and 'Boring' are shown. Bonferroni correction: 0.05/10 = 0.005

[a]Positive: interesting, fun or clear

[b]negative: too personal, annoying, too long, difficult, boring

*p ≤ .05

males and females is allowed (model 3). Dropping A from the model is not allowed (*p* = .0337, model 4). Dropping C from the model is also not allowed (model 5). The best fitting genetic model includes genetic factors (31%), shared environmental influences (36%), and unique environmental influences (43%). The shared environmental correlations (γ) for DOS-twins, same-sex sibs and opposite-sex sibs are estimated at .35, .25, and .40 respectively.

Discussion

Late respondents did not differ much from the early respondents on health-related, lifestyle, and personality traits. Significant associations with late response were found for being male, alcohol use, having a spouse, high experience seeking scores, and judging the questionnaire too long. Regular cycling and judging the questionnaire fun was associated with

Table 4

Logistic Regression Analyses.

Factors:	Category:	OR full model	95% CI	OR best model	95% CI
Constant		0.203		0.204	
Sex	Female (0)				
	Male (1)	1.11	0.92–1.34	1.14	0.94–1.37
Alcohol	Never/less than weekly (0)				
	Weekly/daily (1)	1.22	0.97–1.40	1.20	1.00–1.44
Cycling	No regular cycling (0)				
	Regular cycling (1)	0.86	0.72–1.03	0.83	0.70–0.99
Fulltime job	No fulltime job (0)				
	Having a fulltime job (1)	1.12	0.93–1.34	—	—
Relationship/spouse	No relationship/spouse (0)				
	Relationship/spouse (1)	1.45	1.20–1.75	1.44	1.19–1.74
Test attitude	Subscale ABV (continuous)	1.00	0.99–1.01	—	—
Experience seeking	Subscale SBL (continuous)	1.02	1.00–1.03	1.02	1.00–1.03
Boredom susceptibility	Subscale SBL (continuous)	1.01	1.00–1.02	—	—
Questionnaire too personal	No (0)				
	Yes (1)	1.28	0.93–1.76	—	—
Questionnaire fun	No (0)				
	Yes (1)	0.80	0.66–0.97	0.80	0.66–0.97
Questionnaire too long	No (0)				
	Yes (1)	1.28	1.07–1.53	1.27	1.06–1.52
Being a twin	Twin (0)				
	Singlet al.,on (1)	0.70	0.56–0.86	0.71	0.57–0.88
R^2	Nagelkerke R square	0.041		0.037	
N	Number of Participants included:	2580		2580	

Note: Association between early/late response and lifestyle/health variables in sample of independent subjects (1 person per family, $n = 2795$).
Sex was entered in the analyses in step 1. In the next step the variables with $p \leq .05$ in the univariate analyses were explored with a backward conditional method.
Full model = all variables in the model, best model = variables that were significant in the logistic regression analyses. Dependent variable is early (0) versus late (1) response.

Table 5

Twin and Siblings Correlations with 95% Confidence Intervals for Early (≤ 30 days) and Late (> 30 days) Response

Twin/sib:	r	95% CI
MZM	.62	.45–.76
DZM	.50	.21–.72
MZF	.69	.58–.77
DZF	.53	.33–.69
DOS	.22	.002–.43
Brother–brother	.15	−.07–.34
Sister–sister	.14	.03–.31
Brother–sister	.24	.11–.37

Note: MZM = monozygotic males, DZM = dizygotic males, MZF = monozygotic females, DZF = dizygotic females, DOS = dizygotic opposite sex twin pairs.

early response. Helasoja et al. (2002) also reported that late response was more common among men. Chen et al. (2003) found that late respondents used alcohol more often, which is similar to the results of the present study. In contrast, Korkeila et al. (2001) did not find differences between early and late respondents for heavy alcohol use. Our results showed that early respondents cycled more often. Late respondents more often had a spouse. Other studies investigating early and late response did not include these variables (Helasoja et al., 2002; Korkeila et al., 2001; Rodes et al., 1990). Other health and lifestyle variables were not associated with early/late response. For smoking this is in line with one other study (Chen et al., 2003). However, Korkeila et al. (2001) reported that late respondents were more often current smokers, and Rodes et al. (1990) found a higher proportion of smokers in early respondents, but in men only. The finding that self-reported health was not related with early/late response is in line with results of Chen et al. (2003). Education was not related to late response in our study while Chen et al. (2003) found that delayed response was related to low education (trend $p = .055$). Helasoja et al. (2002) found a relation between education and late response for men in one of the four countries they included. Religion, BMI, having (young) children, cannabis use, and having a full-time job were not associated with early/late response in our sample and were not explored in other studies.

For personality scores no differences between early and late respondents were observed, with the exception of experience seeking. This is in line with results

Table 6
Model Fitting Results for Early Versus Late Response in Total Sample of Twins and Sibs

	Model		−2 LL	df	χ^2	p	Δ df	Vs.	p mix	a^2	c^2	e^2	γ-DOS	γ-SSsibs	γ-OSsibs
1	Full	M	5879.775	5018						.28	.36	.36	.1878	.0033	.2762
		F								.32	.36	.32			
2	$R_c = 1$	M	5892.773	5021	12.998	.0046	3	1		.54	.05	.41	1	1	1
		F								.66	.00	.33			
3	ACE M = f	M+F	5880.044	5021	.269	.8742	2	1		.31	.36	.43	.175	.000	.267
4	CE	M+F	5883.388	5022	3.344	.0675	1	3	.0337	—	.62	.38	.350	.249	.401
5	AE	M+F	5893.531	5022	13.487	.0002	1	3	.0001	.64	-	.36	—	—	—

Note: 1. Full = full model (ACE) with sex-dependent effects; 2. $R_c = 1$; the shared environmental correlation is constrained to be 1; 3. ACE m = f; full model without sex-differences in A, C and E; 4. CE: model without additive genetic influences; 5. AE: model without shared environmental influences.
−2LL = −2 log likelihood; df = degrees of freedom; Δdf = difference in degrees of freedom; χ^2 = chi-square statistic; p = p value; a^2 = estimate additive genetic influence; c^2 = estimate shared environmental influence; e^2 = estimate unique environmental influences; R_c = shared environmental correlation for DOS twin pairs and nontwin siblings; p = p value corresponding to χ^2 (1 df) distribution; p mix = p value corresponding to mixture of distributions of χ^2 (0 df) and χ^2 (1 df).

from other studies. Chen et al. (2003) reported no differences for social conformity, psychological symptoms, neuroticism, and neurological symptoms among early and late respondents. Korkeila et al. (2001) did not find any differences for depression, panic disorder, eating disorder, or other mental disorders. We also explored how participants judged the survey. Late respondents judged the survey more often 'too long' and less often 'fun'. A negative attitude towards health surveys in general was the most common reason for nonparticipation in a study of factors influencing participation in health surveys (Korkeila et al., 2001). Ronmark et al. (1999) reported that the main reason for nonresponse was that subjects forgot to mail the questionnaire, lack of interest, or lack of time. Our sample consisted of twins and their nontwin siblings. Siblings were more often early respondents than twins. This could be due to the research design. Twins had more often been invited in the past to participate in the longitudinal survey study.

In conclusion, late respondents tended to have a somewhat unhealthier lifestyle. The same result was found in a previous study for nonrespondents in which scores for nonrespondents were reflected by the values of responding family members (Vink et al., 2004). In the present study we found that late respondents differed on alcohol use and cycling, but not on smoking and regular exercise. The lifestyle of late respondents falls between the healthy lifestyle of early respondents and the unhealthier lifestyle of nonrespondents. It is therefore recommended to allow a long period of time for data collection, to include late respondents, and get a good reflection of the total population.

Early and late response data were also analyzed with a genetic model. The best model included genetic (31%), shared environmental (36%), and unique environmental influences (43%) on variation in response time. Bhatti et al. (2005) explored genetic variation for willingness to participate in an association study. One of the three groups they analyzed consisted of female subjects who provided a blood sample and who were asked to complete a mailed survey. There were early respondents (n = 679), late respondents (n = 54) requiring an extra incentive to participate, and nonrespondents (n = 50) to the mailed questionnaire. Participants were genotyped for 36 single nucleotide polymorphisms in DNA repair and growth factor genes and 15 short tandem repeat loci. Haplotype frequencies for these genes did not differ. Bhatti et al. (2005) stated that their findings cannot exclude that differences by response exist in other genes, and that the potential for bias due to the 'genetics of response' should continue to be evaluated.

A number of traits that showed association with early/late response in our sample are influenced by genetic factors, such as alcohol use (Koopmans & Boomsma, 1996), experience seeking (Koopmans et al., 1995), having a job (Middeldorp et al., 2006), and having a spouse (Middeldorp et al., 2005). We

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therefore expected that genetic factors would influence variation in early/late response. The heritability was estimated at 31%. This was somewhat lower than the estimate for the percentage of variation explained by shared environment (36%). The average age of the participants was 29 years, with a substantial proportion (about 20%) of the twins still living together with their parents. This may explain the high estimate for the percentage of variation explained by shared environmental influences. Alternatively, returning the survey might be considered an act of altruism. We do not pay subjects or reimburse them in any other way for their participation. For altruism, Koenig et al. (2007) observed in a twin study that only 10% of the variance was genetic, while 28% was due to shared environment.

In conclusion, some differences were found between early and late respondents and it is recommended to allow for a relatively long period of time for data collection. On the other hand, differences between early and late respondents were absent for most of the variables, suggesting that survey studies will not be biased much when they are limited to early respondents.

Acknowledgments

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