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The Reliability of Family Background Effects on Status Attainment: Multiple Informant Models

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Abstract. This article sets out to investigate to what extent conventional retrospective measurement of family background leads to biases in the effects of family background in status attainment research. Multiple informant models show that the effect of father's educational attainment on respondent's educational attainment is 41% greater than conventional research suggests, and that the effect of father's occupational status on respondent's educational attainment becomes zero. The direct effect of respondent's educational attainment on respondent's occupational status is 21% greater after the unreliability in the respondent's answers has been taken into account. We conclude that measurement error seriously biases conclusions about the status attainment process in the Netherlands.

Key words: status attainment, reliability, family background, structural equation models, measurement error

1. Introduction

In social mobility research, information on family background is routinely collected in a retrospective research design. Information on the socio-economic status of parents is measured by asking respondents questions referring to the time when they still lived with their parents. It is a matter of course that errors in the information that respondents give about their parents might bias the size of social mobility. In this article we set out to investigate whether models in which measurement error has been taken into account lead to different conclusions. For this purpose, we estimate multiple informant models in which the information of respondents is combined with information of their parents and their siblings.

The preference for a retrospective research design in social mobility research is understandable, since prospective panel studies would imply

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enormous disadvantages for the research on the impact of social origins on social destinations. First, it would take a long time before researchers would be able to estimate the association between family background and adult socio-economic achievement. Second, the problems of attrition would be hard to solve in a prospective study in which the last wave is 30 years or more after the first wave. Third, mobility research is often interested in historical comparisons. In a prospective research design a historical comparison would be possible only if it is repeated for new birth cohorts, whereas a single retrospective survey covers the life-course of forty years of birth cohorts. It is no wonder that social mobility researchers prefer retrospective measurement of family background characteristics.

In retrospective mobility studies, the respondents answer questions on the socio-economic status of their parents, specifically on the educational attainment and the occupational status of their father and (sometimes) of their mother. Respondents are asked to recall the situation when they themselves were about 12 or 15 years of age. Parental education and occupation are considered to be salient variables, which are easier to remember than less salient (for example attitudinal) variables (Van der Vaart, 1996). Since at age 15 most respondents still lived with their parents, they must have heard about these basic indicators of their parent's socio-economic status, and there seems to be some justification for the assumption that the information supplied by the respondents is reliable. This being so, it is a matter of course that the information cannot be completely correct (Blau and Duncan, 1967; Schreiber, 1975/1976). It is plausible that information respondents supply about their parents' education and occupation is less reliable than the information they supply about their own status. In the first place, there will be additional measurement error because the survey questions refer to a situation in the past (Bradburn et al., 1987; for an overview of research see Dex, 1995). For the youngest respondents in a general population survey the time passed is only a few years, but the oldest respondents are asked to give information about a situation more than 55 years ago. A second reason why there could be additional measurement error is that the questions refer to characteristics of other persons than the respondents themselves. Information about one's own level of schooling or occupation will be more accurate than 'proxy information' about other persons (Blair et al., 1991; for an overview see Looker, 1989). Although the parents are close to the respondents, the details about their schooling and work situation are not so familiar to the respondents to warrant sufficient reliability.

We address the question to what extent the incorrect answers lead to incorrect conclusions about the size of family background effects on socio-economic achievement in the Netherlands. We estimate multiple informant models, using a unique data set in which respondents, one of their parents, and one of their siblings were independently interviewed about the basic family background indicators 'father's occupational status' and 'father's educational

attainment'. We develop structural equation models in which the similarities and dissimilarities in the answers of these three informants provide information on the reliability of the effects that have been found earlier in research in which only the respondents' retrospective information was available.

2. Consequences of Random and Correlated (Systematic) Errors

In general, the consequences of measurement errors depend on the issue whether the errors are random or correlated (systematic). Many errors happen in survey designs. They can result from a lack of precision in the questions in the questionnaire, or from a lack of precision in the answers respondents provide. Errors can also occur when correct information is coded incorrectly. Errors are random if the direction of the error is not correlated with characteristics of the respondents, or, in our study, with characteristics of the parents of the respondents. Random measurement error in family background variables will lead to an underestimation of family background effects on adult status (in bivariate analyses) and thus to an overestimation of social mobility. Things can become more complex when random measurement error varies between variables. If random measurement error in one independent variable is larger than in a second independent variable, the effect of the first variable may be underestimated, while the effect of the second one may be overestimated.

Measurement errors are correlated if they do correlate with characteristics of the respondents or their parents. One source of correlated measurement error may occur when the tendency to give socially desirable answers is related to individual characteristics. For example, if higher educated respondents overstate the educational level of their parents and if they do more so than lower educated respondents, research would produce a too strong association between parents' and respondent's educational attainment. Answers to leading questions and halo effects are other reasons why measurement errors could lead to correlated measurement errors, if the incorrect answers occur more among some categories of respondents than among others, or if they blow up the correlations. The relationships between variables that suffer from correlated measurement errors and other variables can be underestimated or overestimated, depending on the direction of the bias. We do not know of any elaborated theory on the direction of the bias in status attainment research, but we have some preliminary ideas. We think that in status attainment models correlated errors most probably lead to an overestimation of effects. Answers to retrospective questions about the educational attainment and occupational status of one's parents, when asked for the situation the respondent was between 12 and 15 years old, could be biased in the direction of the present status of the respondent. The reason is that respondents

might, intentionally or unintentionally, have a preference to minimize the social distance between themselves and their parents. A classical finding from psychological research is that people tend to minimize the differences in personality, taste, and status with people for whom they have affective feelings (Fiedler et al., 1952; Michaelson and Contractor, 1992), and this mechanism may be present for the relationship between parents and children. An opposite, to us less plausible, argument is that people, again intentionally or unintentionally, tend to underestimate their parents' educational attainment or occupational status to make it look that they have made their career on their own, without parental support (Broom et al., 1978). If this tendency occurs especially under the successful people, the correlation between family origins and achieved status might be underestimated.

If a systematic bias exists that inflates the association between family background and adult status, it is not straightforward how this would affect the estimated effects in status attainment models. Several outcomes are possible. First, it is possible that random errors and correlated errors cancel each other out. Random errors have a negative impact on the effects of family background, and correlated errors have a positive impact on these effects, and if the sizes of these biases are equal, the result is there is no bias found in the effects.

Second, if random errors are stronger than correlated errors, models that control for measurement error will probably produce stronger effects of family background than models without such controls. However, one has to keep in mind that the random error could be higher for some variables than for others. For example, father's level of education is less visible to children than father's occupation (and the level of the education may even be less visible than the direction of the education), which might result in higher random error in father's education than in father's occupational status. This could result in an underestimation of the effect of father's education on respondent's education, and in an overestimation of the effect of father's occupational status (controlling for father's educational attainment).

Third, if correlated errors are stronger than random errors, models that control for measurement error might produce smaller effects than conventional models.

Fourth, it is possible that respondents make their answers on different indicators of family background more consistent than they really are. This interesting and not unlikely scenario would materialize when respondents make different family background indicators consistent, for example "My father had a high status job, so his education was probably high as well". When this overestimation of the correlation between father's occupational status and father's educational attainment has been corrected, the effects of family background will change, but it is uncertain which effects will become larger or smaller.

It is clear that these considerations do not lead to straightforward hypotheses about the consequences of measurement error on the effects in the status attainment model. In general, random error will cause estimated effects of family background to be lower than the true ones, whereas correlated error can lead to estimates that are higher than the true effects. However, we are looking at a path model, with more than one independent variable, and this may result in deviations from the general consequences of random and correlated error, since both direct and indirect effects might be biased. It is unclear which bias is the strongest. Empirical research must show which arguments carry the most weight.

3. Previous Research

Various studies have investigated the bias due to measurement error in family background variables, which have all in common that they use multiple measurements of the same variables. Bowles (1972) compared retrospective survey-answers about father's occupation at age 16 with census information, and found the Pearson's correlation between these two variables to be $r = 0.74$. Assuming that the reliability of father's educational attainment has the same size as the reliability of father's occupational status, Bowles concluded that measurement error leads to an underestimation of the effect of both father's occupation and education variables on the respondent's educational attainment and income.

Bielby and Hauser (1977) and Bielby et al. (1977a,b,c) re-interviewed part of their sample three weeks after the first interview. The test-retest reliability coefficients of father's educational attainment and father's occupational status for non-blacks proved to be rather high: for father's education the correlation is $r = 0.94$, while for father's occupational status the correlation is $r = 0.87$. The authors further concluded that measurement error is random and that the reliability of family background characteristics is as high as the reliability of the respondent's own characteristics. The inclusion of measurement error in linear structural models showed that the effect of father's occupational status is underestimated in research in which only one measurement moment is used, but that the effect of father's educational attainment is not biased. Bielby et al. (1977c) also looked at the consequences for the status attainment model of blacks. The reliability of their answers turned out to be lower than the reliability of whites, and errors turned out to be correlated. A re-analysis by Allison and Hauser (1991) of the data of Bielby et al. for non-blacks, using the multiple group option to deal with missing data, yielded the same results, except that in the analysis of Allison and Hauser the effect of parental income on occupational status turned out to be smaller after correction for measurement error.

Broom et al. (1978) estimated two alternative models for the effects of father's educational attainment and occupational status on son's educational attainment and occupational status: the first model used information obtained from the sons only and the second model used information obtained from the fathers only. The effects of social background on son's educational attainment and the effect of father's occupational status on son's occupational status are stronger when fathers' information was used.

Corcoran (1980, 1981) used data from interviews with both young adults and their parents. The offspring turned out to make answers on different parental characteristics more consistent than they really were. In general, adult children's reports were as reliable as those of their parents, except that the son's answer on mother's education was less reliable than the parental answer. Correction for measurement error led to slight changes of parameter estimates only: the effect of father's education on son's education became stronger, as did the effect of mother's education on daughter's education.

In the well-known Wisconsin panel study (Sewell and Hauser, 1980; Hauser et al., 1983; Massagli and Hauser, 1983) respondents were interviewed in 1957, in 1964, and in 1975. In addition, a concise description of father's occupation in tax-records was present. Further, information given by parents and siblings of the primary respondents has been used. For father's educational attainment, mother's educational attainment, and father's occupational status, Hauser et al. (1983) reported reliabilities of $\alpha = 0.68$, $\alpha = 0.62$, and $\alpha = 0.75$ respectively. Further, the Wisconsin team found that the error in father's education was correlated with the error in father's occupation, but that the error in socioeconomic background was not related with respondent's educational or occupational attainment. Their model turns out to be more powerful in explaining educational attainment and occupational status than previous research without correction (Hauser et al., 1983).

Massagli and Hauser (1983) investigated the consequences of measurement error in father's occupation, parents' income, son's education, and son's occupation. The bivariate correlations between these variables turned out to be underestimated if error is not accounted for. A disadvantage of the Wisconsin data is that parents were asked about the present occupation of their sons in 1964, while sons were asked about their present occupation in 1975 (Massagli and Hauser, 1983).

Hope et al. (1986) re-interviewed ten percent of their original sample (in England and Wales) after two years. The reliability coefficients of father's education and father's occupational status were 0.72 and 0.76, respectively. The researchers concluded that unreliability leads to an underestimation of the relationship between father's and son's characteristics.

Van Eijck (1996) estimated models in which the information on family background characteristics originated from the primary respondent and from one randomly selected sibling. The effect of father's occupation on

educational attainment was estimated to be slightly greater in the multiple informant model, whereas the effect of father's educational attainment was slightly larger.

According to Breen and Jonsson (1997), who used data from a Swedish panel-study in which questions about father's occupation and own occupation were repeated, ignoring measurement error leads to an underestimation of inheritance effects.

4. Multiple Informant Design

In this review of the research literature concerned with the consequences of measurement error in retrospective questions, three research designs can be distinguished, which can be labeled the multiple moment design, the multiple source type design, and the multiple informant design.

In the multiple moment design respondents are asked the same questions more than once, often in the successive waves of a panel study. Above we discussed the studies of Bielby and Hauser (1977), Bielby et al. (1977a,b,c), Sewell and Hauser (1980), Hauser et al. (1983), Hope et al. (1986), Allison and Hauser (1991), and Breen and Jonsson (1997). The multiple moment design has two problems. The first one is clear from the large difference in the sizes of the reliability coefficients between different studies which show that the larger the period between the moments on which the same questions are asked, the higher is the estimated error. The reliability coefficients are highest when the moments are three weeks apart, lower when the moments are two years apart and lowest when the moments are eleven years apart. In our view, the unreliability coefficient depends too strong on the time between the surveys. The second problem with the multiple moment design is caused by attrition, which is most problematic if the time between the two measurement moments is long.

In the multiple source type design, different *types* of sources are used, for example when retrospective survey data provided by respondents is compared with external registered data such as registered data in government files or with data from pay rolls. The second source typically is not collected for research purposes and is not collected in surveys. Although the information from registered data is very reliable, this design has been used for father's occupational status and family income only (in the studies by Bowles (1972), Hauser et al. (1983), and Massagli and Hauser (1983) discussed above), but not for other family background variables. Probably there are no sources available to look up these other family background variables. In general, privacy regulations can be a serious handicap for this design.

In the multiple informant design, more than one person is asked about family background variables, for example primary respondents, parents, and siblings. The studies of Broom et al. (1978), Corcoran (1980, 1981), Hauser et al. (1983), Massagli and Hauser (1983), and Van Eijck (1996) discussed above use this design. This is the design we prefer, since the multiple source type design is not feasible for most family background variables, and because the multiple moment design respondents can give the same wrong answers in each interview. It is important to note that the multiple informant design has two possible disadvantages. First, it is often impossible to interview all relevant informants, especially because many respondents, especially older people, often do not have living parents. A second problem, which we think here is less serious than in the multiple moment design, is the possibility that the different informants provide the same wrong information about family background indicators.

5. Data, Descriptives, and Models

5.1. DATA

The data we analyze are from the repeated cross-sectional retrospective life-course survey Family Survey Dutch Population 1992, 1998, and 2000 (Ultee and Ganzeboom, 1992; De Graaf et al., 1998, 2000). In these three surveys, primary respondents and their (married or unmarried) spouses were interviewed in face-to-face interviews plus self-completion questionnaires. Samples were drawn from the population registers from a representative selection of Dutch municipalities. The response rate (= contact rate $\times$ cooperation rate) was 42.5% in 1992, 47.3% in 1998, and 40.6% in 2000. The contact rates were about 90%, and the co-operation rates about 50%. The resulting sample sizes are 1000, 2029, and 1561 respondents, respectively, producing a total of 4590 respondents.

Since many of the older respondents do not have living parents, and as we want to avoid that the parental source addresses respondents in a different age range than the respondent and sibling sources, we included in the analysis only respondents of 54 years or younger. Of these respondents, 85.6% had at least one living parent at the time of the interview. In addition, about 89.5% of the respondents (in the 1992 and 2000 surveys¹) reported to have at least one living sibling. We have made a second age selection by excluding respondents under age 25, since many of the younger respondents had not finished their educational career at the time of the interview, and as a consequence do not have a steady occupation yet. These age selections leave us with a total of 3138 respondents for whom we have valid respondent information on father's educational attainment

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and occupational status, and on respondent's educational attainment, occupational status, birth year and sex.

Respondents were asked to give their parents' address and the address of one randomly selected sibling. The siblings and parents then were sent a questionnaire by mail, with a stamped return envelope. After two reminders, the second one with a fresh questionnaire and return envelope, completed parent questionnaires were received for 43.3% of the respondents with living parents. The response rate of siblings under respondents with at least one living sibling was 39.4%. The non-response has two causes: some respondents did not give the address of their parents or siblings, and some parents and siblings did not return the questionnaire they received. Not all questionnaires contain all information we want to include in our analysis: in 1998, parents were asked only about their education and not about their occupation when the primary respondent was 15 years old, and in all three questionnaires no questions were asked about deceased spouses of the surviving parent. This makes that, although we have data on 3,138 respondents between 25 and 54 years old who answered the question about their father's education and occupation, we have parent reports on father's education for 897 respondents, and parent reports on father's occupation for 404 respondents. In addition, we have sibling reports on father's education and father's occupational status for 617 and 583 respondents, respectively.

The status attainment model that we estimate deviates in three ways from the status attainment model as proposed by Blau and Duncan (1967). First, we have included men and women in one model, while controlling for sex. Men and women are analyzed together to increase statistical power and because we will not investigate male/female variation in the reliability of the information on family background. Second, to simplify our analysis we do not include first occupation in the model; life-course development in occupational status is controlled for by the inclusion of the respondent's age in the model. Third, we limit the sample to respondents between ages 25 and 54. The information from older respondents is not useful for our analysis since not many of them have living parents who can participate in the survey, and, when they have living parents, these are very old which would lead to a low response rate.

Highest completed education of fathers and sons/daughters is the number of years necessary to complete the level of education: primary school is 6 years of schooling, lower vocational training (LBO) is 9 years, lower general education (MAVO) and short intermediate vocational training (KMBO) are 10 years, normal intermediate vocational training (MBO²) and intermediate general education (HAVO) are 11 years, pre-university education is 12 years (VWO), higher vocational training (HBO) is 15 years, university (WO) is 17 years, and post-university is 20 years. Occupational status

of fathers and sons/daughters is coded according to the International Socio Economic Index (ISEI) scale, as constructed by Ganzeboom et al. (1992).

In the status attainment models to be estimated we will include sex and birth year as control variables. Although sex differences have decreased significantly, we expect to find that women attain lower levels of educational attainment and occupational status. We include birth year in the models too, because younger cohorts have attained higher levels of schooling. Both a cohort effect and an age effect lead to a negative effect of birth year on occupational status. Age has a positive effect on occupational status because of career development; this implies a negative effect of birth year. Moreover, it has been found that, when educational attainment is controlled for, younger cohorts attain lower levels of occupational status than older cohorts. The reason for this negative effect of birth year is the decreasing value of diplomas in the Netherlands. The average level of schooling has increased stronger than the average level of occupations; this process is often labeled as diploma inflation (Wolbers, 1998).

5.2. DESCRIPTIVES

In Table I we present basic descriptive information on the variables we use in the analysis. Father's educational attainment comes from three informants, and Table I reports on the similarities in the answers of three types of pairs: respondent-parent pairs ($n = 897$), respondent-sibling pairs ($n = 617$), and parent-sibling pairs ($n = 287$). According to the 3138 respondents in the analysis the average education of their fathers is 9.27 years (including 6 years of primary education). The respondents of whom we have direct information by their parents have reported a higher educational attainment for their father (average is 10.08 years). This could be due to selective mortality and higher educated parents belonging to the younger birth-cohorts. Moreover, among the living parents, higher educated parents might have a higher response rate. Further, it turns out that parents on average have reported less years of education than their sons or daughters (respondents and their siblings) reported; these differences are significant ($p < 0.05$). The correlation of the answers of parents with those of the respondents is 0.806 and with the answers of siblings is 0.847. The fact that the parent-sibling correlation is higher than the parent-respondent correlation implies that the siblings in our analyses may be a more selective and hence more motivated subgroup that gives more reliable answers than the primary respondents. In the respondent-sibling pairs the averages are about equal and the correlation between the answers is 0.800. Cronbach's alpha reliability coefficient of father's educational attainment is rather high, namely 0.931. Note that this is the reliability of the educational attainment if measured using three informants. The fact that this reliability is high

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Table I. Descriptive information about all variables in the analysis

	<i>n</i>	Mean	S.D.	<i>r</i>	α
<i>Father's educational attainment</i>					
(in years: range 6–20)					0.931
All respondents	3138	9.27	3.36		
Respondent-parent pairs: respondent	897	10.08	3.40	0.806	
parent	897	9.80	3.55		
Respondent-sibling pairs: respondent	617	9.37	3.39	0.800	
sibling	617	9.31	3.33		
Parent-sibling pairs: parent	287	9.56	3.62	0.847	
sibling	287	9.87	3.53		
<i>Father's occupational status</i>					
(ISEI: range 10–90)					0.927
All respondents	3138	44.76	16.28		
Respondent-parent pairs: respondent	404	46.84	16.87	0.781	
parent	404	47.18	17.75		
Respondent-sibling pairs: respondent	583	45.66	16.92	0.788	
sibling	583	46.52	17.13		
Parent-sibling pairs: parent	240	46.77	17.32	0.860	
sibling	240	47.56	17.23		
<i>Respondent's educational attainment</i>					
(in years: range 6–20)	3138	11.59	3.23		
<i>Respondent's occupational status</i>					
(ISEI: range 10–88)	3138	49.76	16.02		
<i>Female</i>					
(male = 0, female = 1)	3138	0.50			
<i>Birth year (range 1938–1975)</i>					
(1938 = 0, 1975 = 37)	3138	19.37	8.41		

Bold figures indicate that the difference between the means is significant at the 0.05 level (two-sided test).

α = Cronbach's alpha reliability coefficient based on the three correlations.

does not mean that the individual items do not contain much error. However, the combination of these three items (each measured with error) leads to a highly reliable estimate of father's educational attainment.

Father's occupational status is reported to be slightly higher when there is a participating parent or sibling than in the whole age group 25–54. In general, however, neither interesting nor significant differences can be observed. The correlation coefficients within the three pairs of informants are 0.781, 0.788, and 0.860, and the overall reliability coefficient is 0.927. The descriptives of the other variables are reported for the sake of completeness.

5.3. MODELS

We will estimate four linear structural models. These models are estimated with the LISREL software (Version 8.54), and accordingly we present the model parameters following the LISREL notation. The first (see Figure 1) is a model in which only information provided by primary respondents is used. In conventional research, this information is assumed to be measured without error. For that reason, we do not incorporate measurement error in Model 1.

In the second model, graphically represented by Figure 2, the information on father's educational attainment and occupational status comes from three informants: the primary respondent, a parent, and one randomly selected sibling. In the estimated models we can find answers to the question whether correction for measurement errors leads to different estimates of the effects of family background on educational attainment and occupational status. Father's educational attainment and occupational status are treated as latent variables (η_1 and η_2) with each three indicators, Y_1, Y_2, Y_3 , and Y_4, Y_5 and Y_6 , respectively.

Figure 1. Model without measurement error.

Figure 2. Model with random measurement error.

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Although the focus of this study is on measurement error in family background characteristics, we also account for measurement error in the reports of respondent's own educational attainment and occupational status, since measurement error in these variables can also affect the effects of family background. We have multiple measurements for these variables in the 2000 survey only, which implies that we cannot correct for measurement error in the full analysis. In the 2000 survey the parents have been asked about the educational attainment and occupational status of their children. On the basis of the correlations between the parental reports and the respondent reports we fix the reliability of educational attainment to 0.85 and the reliability of occupational status to 0.80. This is in line with Hope et al. (1986), Hauser et al. (1983), and Bielby et al. (1977a,b,c), but Glebbeek (1993) finds a test-retest reliability of about 0.70 for occupational prestige. The reliabilities imply that about 15 and 20% of the variance in educational attainment and occupational status respectively is error variance ($1 - r$). We computed the (unstandardized) error variances by hand (Hayduk, 1987), and included the estimates in the measurement model of the full analysis. In addition, we perform a sensitivity analysis by estimating the models fixing the error variance 5% points higher and 5% points lower. Further, we assume that respondent's birth year and sex are not subject to measurement error, since previous research showed that the reliability of these variables is very high (Schreiber, 1975/1976; Porst and Zeifang, 1987; Poulain et al., 1992). The outcomes of this model will be compared with the effects of the status attainment model as estimated with the family background information reported by the 3138 primary respondents only (Figure 1).

Figure 3 represents the correlated measurement error model. We will test whether respondent's report on father's educational attainment and father's occupational status is directly linked to the respondent's own educational attainment and occupational status. This would mean that there is some correlated measurement error. Furthermore, we will investigate whether respondents and siblings make father's education and father's occupation more consistent than they really are. These types of correlated measurement error will then be controlled for by the inclusion of error-covariances.

The fourth model (see Figure 4) uses only information provided by primary respondents. However, measurement error in their answers on their father's education and occupation, as estimated in Models 2 and 3, is incorporated. This is done in the same way as we incorporated measurement error in the respondent characteristics in Models 2 and 3. In this way we show that our information on measurement error can be used to correct for error if only respondent information is present.

Figure 3. Model with correlated measurement error.

Figure 4. Model with imputed measurement error.

We assess the model fit with three statistics: the Chi-square, the BIC, and the RMSEA. The Chi-square tests whether the model fit of the estimated model deviates from the saturated model. A significant Chi-square means that the model fit is significantly worse than that of the saturated model. A disadvantage of the Chi-square is that it is likely to become significant when the sample size is large. Therefore, the BIC (= Bayesian Information Criterion, Raftery, 1993, 1995) takes the number of cases into account. A negative BIC value means that the model is a better representation of the data than the saturated model. For large models, estimating more effects (and hence losing degrees of freedom) is less likely to improve the BIC value although it could improve the Chi-square statistic. The Root Mean Square Error of Approximation (RMSEA) is the average error per degree of freedom and takes the sample size into account as well. A value

below 0.05 is usually considered to imply a good fit (Browne and Cudeck, 1993).

6. Missing Value Problems

As noted above, we do not have complete information for all respondents. Table II gives additional information on the missing value structure in our data. We distinguish between five groups. Respondents for whom we have information on father's education and father's occupation from all three informants are in Group A ($n=226$). The other four groups have at least one missing informant. In Group B ($n=161$) there is no sibling information, and in group C ($n=336$) there is no parent information. In Group D we rank 464 respondents for whom we do not have sibling information and no parent information on father's occupation (mainly respondents from the 1998 questionnaire). The largest category is Group E with 1,951 respondents for whom we have no other informants than the primary respondents.³ In the LISREL software it is possible to include all five groups in a single analysis, since one latent variable can be measured by different numbers of indicators over groups of respondents, using the multiple-group option in the LISREL software. If there is no parent or sibling report on a given family background variable, the mean and the covariances of that indicator with all other variables in the analysis are set to zero, while the variance is set to one. In addition, the effect of the latent variable on this indicator is set to zero (Jöreskog and Sörbom, 1996). Further, the regression effects are restricted to be equal over the five groups.⁴ The means of the indicators (if they are not missing) in the different groups have to be restricted to be equal, if the data are missing at random (MAR) instead of missing completely at random (MCAR). Possible differences between the groups are not worrying, since this method gives reliable results if data are either MAR or MCAR (Allison, 1987). Still, these differences do deteriorate the fit statistics. Since these fit statistics test at the same time whether the model fits the data well and whether missing values are MAR instead of MCAR, we also provide the fit statistic for the model where the means are not restricted to be equal. Note that in Group E, in which we have included the respondents for whom we do not have additional family background information by a parent or a sibling, the estimated effects are also corrected for measurement error, since the errors are restricted to be equal to those in the group of the respondents of whom we do have information from parents or siblings.

But what if data are not missing at random? It is very well possible that especially the most motivated parents and siblings, who give the most reliable answers, return the questionnaire. This does not necessarily cause

Table II. Missing value structure: sample size of five subgroups

Group	Father's education and occupation according to primary respondent	Father's education according to parents	Father's occupation according to parents	Father's education and occupation according to sibling	<i>n</i>
A	Known	Known	Knowns	Known	226
B	Known	Known	Known	Missing	161
C	Known	Missing	Missing	Known	336
D	Known	Known	Missing	Missing	464
E	Known	Missing	Missing	Missing	1,951
Total					3,138

problems. We allow the errors in the answers of parents and siblings to differ from the errors in the answers of respondents. If parents and siblings are a more selective subgroup giving more reliable answers, this does not influence our estimate of the error in the answers of respondents. Another cause for non-random missingness is that we may have parental questionnaires of especially those respondents who have the best contacts with their parents, since those respondents are most likely to give the (correct) address of their parents and those parents are most likely to cooperate with a survey in which their son or daughter participated. Moreover, those respondents might be more likely to give reliable answers about their parents. We have tested these assumptions using information about the contact between parents and children. Indeed, we obtained a lower parental response rate for respondents who hardly have any contact with their parents. Fortunately, the group of people who have (almost) no contact with their parents is very small: 2% visit their parents once a year or less, 8% are visited by their parents once a year or less, and 11% have telephone contact with their parents a few times a year or less. In addition, no difference in parental response rate exists between those respondents who have intermediate contact with their parents and those who have frequent contact with their parents. More importantly, the correlation between the answers of respondents and parents is not lower for those respondents who hardly have any contact with their parents than for those respondents who have intermediate or frequent contact. This makes it less likely that our estimate of the reliability is biased by selective non-response.

6.1. MODEL I: NO MEASUREMENT ERROR

Model 1 in Table III is the baseline model of our analysis. This model uses only the primary respondent as informant for father's educational attainment and father's occupational status. In other words, this linear structural model is the same model as estimated by ordinary least square regression analysis. The difference is that the LISREL approach presents goodness of fit statistics. The Chi-square is 5.884 with three degrees of freedom, which refer to the relations between female and father's educational attainment and occupational status and the effect of father's educational attainment on respondent's occupational status. These relations were restricted to be zero, since we found these relations to be empirically absent and since they are theoretically not justified. The model fits the data well, according to the Chi-square, the BIC, and the RMSEA.

The model estimates, as reported in Table III, are in line with previous research, which found that in the Netherlands, father's educational attainment and occupational status both have positive effects on the respondent's educational attainment (De Graaf and Ganzeboom, 1993; De Graaf and Luijkx, 1993), but the effect of father's educational attainment is much stronger than the effect of father's occupational status. This finding has often been used to argue that the cultural dimension of social stratification plays a larger role in the Dutch process of status attainment than the economic dimension of social stratification: in the Netherlands culture matters more than money to further one's offspring's life-course (De Graaf et al., 2000). The educational attainment of women is lower than that of men and younger birth-cohorts attained a higher level of education.

Furthermore, the respondent's occupational status is strongly dependent on the respondent's educational attainment, but the effect of father's occupational status is substantial too (De Graaf and Luijkx, 1995). As expected, the effect of educational attainment is much stronger than the effect of father's occupational status. Previous research found a somewhat stronger effect of educational attainment on occupational status than 0.499. De Graaf (1987) found a standardized effect of 0.57 for the Netherlands, while Duncan (1967) found a standardized effect of 0.52 for the United States. The difference might be explained by the fact that they analyzed only sons, while we analyze both sons and daughters. For women in the Netherlands the effect of education on occupational status might be lower due to the fact that they often have part-time jobs. If we perform our analysis for sons only, we find a standardized effect of 0.520, while an analysis for daughters only yields a standardized effect of 0.476. Furthermore, Table III shows that women have a lower occupational status than men. The younger birth-cohorts have a lower occupational status than the older

cohorts (after controlling for educational attainment), which is a replication of the findings of Wolbers (1998).

The conclusion is that achievement plays a much more important role on the Dutch labor market than ascription, although it must be recognized that educational attainment functions as an important channel of intergenerational transmission of socio-economic status.

6.2. MODEL 2: RANDOM MEASUREMENT ERROR

Model 2 in Table III allows for random measurement error. The fit statistics provide ambivalent information about the model fit. The Chi-square is significant (for both the model with and without the restriction of equal means over missing value groups). However, this might be due to the large sample size. The BIC-value is negative and the RMSEA is below 0.05. We conclude that the model fit is satisfactory.

Table III shows that there are differences in the parameters of the status attainment model after measurement error has been taken into account. In Model 2 the standardized effect of father's educational attainment on respondent's educational attainment is 41% larger than the effect in the baseline model, and the standardized effect of father's occupational status on respondent's educational attainment is 64% smaller and has become statistically insignificant. The difference in the effect of father's educational attainment is statistically significant, while the difference in the effect of father's occupational status is on the borderline of significance ($p < 0.07$) for a two-sided test.⁵ It is important to note that the correlation between father's education and father's occupation in the model with measurement error is 31% (0.764 instead of 0.584, not shown in Table III) larger than in the baseline model. We conclude that the effect of father's occupational status on respondent's educational attainment is smaller due to the fact that the effect of father's education on respondent's education and the correlation between father's education and father's occupation are larger. If measurement error is not accounted for, father's educational attainment is not completely represented by the measurement of father's educational attainment. Part of father's educational attainment is presumably represented by father's occupational status, which makes that father's occupational status has a significant effect on son's/daughter's educational attainment.

Table III further shows that the standardized effect of respondent's educational attainment on respondent's occupational status, which is already

Table III. Effects of social background, female, and cohort on respondent's educational attainment and occupational status

	Model 1 no measurement error			Model 2 random measurement error			Model 3 correlated measurement error			Model 4 imputed measurement error		
	<i>b</i>	Standard Beta error	<i>b</i>	Standard beta error	<i>b</i>	Standard Beta error	<i>b</i>	Standard Beta error	<i>b</i>	Standard Beta error	<i>b</i>	Standard Beta error
<i>Effects on respondent's educational attainment</i>												
Father's educational attainment (6–20)	0.300	0.020	0.311	0.444	0.043	0.440	0.412	0.050	0.408	0.440	0.045	0.436
Father's occupational status (10–90)	0.025	0.004	0.127	0.010	0.009	0.046	0.015	0.010	0.068	0.012	0.010	0.055
Female (male = 0, Female = 1)	– 0.536	0.104	–0.083	– 0.540	0.104	–0.091	– 0.537	0.104	–0.090	– 0.537	0.104	–0.090
Birth year (1938 = 0, 1975 = 37)	0.031	0.006	0.080	0.022	0.007	0.061	0.024	0.007	0.066	0.023	0.007	0.066
<i>R</i> square	0.183			0.250			0.239			0.254		
<i>Effects on respondent's occupational status</i>												
Father's occupational status (10–90)	0.141	0.015	0.143	0.148	0.021	0.145	0.142	0.026	0.139	0.145	0.022	0.142
Respondent's educational attainment (6–20)	2.476	0.078	0.499	2.910	0.100	0.605	2.927	0.103	0.608	2.912	0.101	0.605
Female (male = 0, female = 1)	– 1.889	0.475	–0.059	– 1.640	0.479	–0.057	– 1.648	0.479	–0.057	– 1.612	0.479	–0.056
Birth year (1937 = 0, 1975 = 38)	– 0.112	0.028	–0.059	– 0.136	0.029	–0.080	– 0.137	0.029	–0.080	– 0.136	0.029	–0.080
<i>R</i> square	0.318			0.455			0.455			0.455		
Chi-square	5.884			513.826		211.779	508.782		207.220	7.984		
<i>df</i>	3			177		148	173		144	3		
RMSEA	0.018			0.025		0.012	0.026		0.012	0.023		
BIC	–24			–911.261		–979.819	–884.100		–952.173	–16.170		
<i>n</i>	3138			3138			3138			3138		

Bold figures indicate that the effect is significant at the 0.05 level (one-sided test).

Fit statistics in italic belong to a model in which the means of the indicators in the different subgroups are allowed to differ.

very strong in Model 1, is 21% larger when measurement error is controlled for. This difference in effect is statistically significant ($p < 0.05$). The unstandardized effect of father's occupational status on respondent's occupational status has hardly changed. Apparently, the status attainment process in the Netherlands is even more education driven than earlier research has shown. Status is inherited through educational paths: father's education and not father's occupation affects children's educational attainment, and the effect of education on occupation is stronger than models without control for measurement error suggest.

We investigated whether different error-variances in the respondent characteristics would lead to different results. Analyses were performed in which proportions of error-variance were fixed 5% points lower (i.e., 0.10 and 0.15 for educational attainment and occupational status, respectively) and 5% points higher (i.e., 0.20 and 0.25, respectively). Neither of these analyses yielded different conclusions.

6.3. MODEL 3: CORRELATED MEASUREMENT ERROR

In this section, we focus on correlated measurement error. Correlated measurement errors are measurement errors that are related to characteristics of respondents or their parents. In Table IV we present a regression analysis in which the answers of primary respondents about their father's educational attainment and occupational status are predicted by (i) the information the parents have provided about the educational attainment and occupational status, (ii) the corresponding characteristic (education or occupation) of the respondents themselves, and (iii) the other characteristic of the father. If there is no correlated bias related to the respondent's socio-economic attainment, the characteristics of the respondents will not have any effect on the information they have given about their fathers.

Table IV suggests that correlated measurement error is present. Respondent's answer about father's occupational status has a positive and significant effect on the information he or she has given about father's educational attainment, and respondent's report on father's educational attainment has a significantly positive effect on the answer he or she has given about father's occupational status. Furthermore, there is a direct effect of respondent's own occupational status on father's occupational status as reported by the respondent. This suggests that the answers given by respondents about the socio-economic status and education of their father are biased, in the direction of their own socio-economic status. Nevertheless, this is not the ultimate test for measurement error, since answers of parents are not necessarily correct. To perform a better test of correlated measurement error and to correct for this type of measurement error, in Model 3 we allowed the errors in respondent's and sibling's

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Table IV. Bias of reported father's educational attainment and father's occupational status toward characteristics of the respondent and the father

Source	Variable	Father's educational attainment			Father's occupational status		
		<i>b</i>	Standard error	Beta	<i>b</i>	Standard error	Beta
Parent	Father's educational attainment (6–20)	0.670	0.025	0.698			
Parent	Father's occupational status (10–90)				0.601	0.039	0.632
Respondent	Father's educational attainment(6–20)				0.942	0.197	0.192
Respondent	Father's occupational status (10–90)	0.032	0.005	0.156			
Respondent's educational attainment (6–20)		0.024	0.023	0.022			
Respondent's occupational status (10–90)					0.063	0.034	0.060
<i>R</i> square (adjusted)		0.664			0.633		
<i>n</i>		897			404		

Bold figures indicate that the effect is significant at the 0.05 level for a one-sided test.

answers on father's educational attainment and occupational status to correlate. Furthermore, we allowed the error in respondent's information on father's educational attainment and occupation to be correlated with the errors in respondent's answers on own educational attainment and occupation respectively. Table V shows the error-covariance between father's educational attainment and father's occupational status. Neither in the information provided by respondents, nor in the information provided by siblings, the error-covariance is significant; the error-covariance for respondent information not even has a positive sign. The same applies to the bias in respondent reports on father's educational attainment and father's occupational status towards respondent's educational attainment and occupational status, respectively, as presented in Table VI.

The fit statistics for Model 3 in Table III are similar to those of Model 2. The difference in Chi-square is not significant. Furthermore, correlated measurement error does not result in different estimates of the structural effects in the status attainment model.

Fixing the proportions of error-variance in respondent's educational attainment and occupational status 5 percent-points lower does not lead

Table V. Correlation between errors in answers on different family background variables

	Covariance	Standard error	Correlation
Respondent information: father's educational attainment and father's occupational status	-0.087	0.605	-0.002
Sibling information: father's educational attainment and father's occupational status	0.898	0.751	0.016

Table VI. Correlation between errors in answers of respondents about their father and about themselves

	Covariance	Standard error	Correlation
Father's and respondent's educational attainment	0.185	0.136	0.017
Father's and respondent's occupational status	2.395	3.566	0.009

to different results. However, if the measurement error in son's/daughter's educational attainment is set to 20% instead of 15%, i.e., 5 percent-points higher than could reasonably be expected, the effect of father's occupational status on son's/daughter's educational attainment becomes significant again ($p < 0.05$, for a one-sided test).

6.4. MODEL 4: IMPUTED MEASUREMENT ERROR

In the previous sections we found that the error variance in both father's occupational status and father's educational attainment is rather substantial and affects the estimates of the status process in the Netherlands in important ways. Therefore, we recommend to include our estimates of the error variances in future research. Based on the 2000 Family Survey Dutch Population we found that for primary respondents the error variance in educational attainment and occupational status is about 15 and 20%, respectively. The effects of the latent father characteristics on their indicators (the LY in LISREL terms) are shown in Table VII. It turns out that the effects on the paternal answers (0.914 and 0.917 for father's educational attainment and father's occupational status, respectively) are significantly stronger than those on the answers of primary respondents (0.879 and 0.860, respectively). The square of the standardized effect refers to the reliability. Table VIII presents the error-variance in the information provided by the three informants as a proportion of the total variance. The

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Table VII. The effects of latent paternal characteristics on their indicators

	Indicator respondent			Indicator parent			Indicator sibling		
	Effect	Standard error	Standard-ized	Effect	Standard error	Standard-ized	Effect	Standard error	Standard-ized
Father's educational attainment	1.000	–	0.879	1.094	0.028	0.914	1.018	0.031	0.905
Father's occupational status	1.000	–	0.860	1.128	0.039	0.917	1.096	0.035	0.912

The effects of the latent variables on the respondent-indicators are set to one.

Table VIII. The proportion of indicator error variance

	Indicator respondent	Indicator parent	Indicator sibling
Father's educational attainment	0.227	0.165	0.182
Father's occupational status	0.260	0.159	0.169

information provided by primary respondents is less reliable than those by parents and siblings, possibly because parents and siblings are a more selective subgroup. The error-proportions for primary respondents are about 0.25.

In Model 4 of Table III we imputed these proportions of error variance in Model 1, that is the model with information by the respondents only. The Chi-square is now significant due to the fact that father's educational attainment now has a significantly negative effect on son's and daughter's occupational status, which is restricted to be zero in the model. The test is whether Model 4 produces the same effects as Models 2 and 3 and this indeed appears to be the case. The estimates of Model 4 show (i) that father's education has a strong effect on respondent's educational attainment, stronger than a model without correction suggests, (ii) that in contrast to what previous research concluded, there is no effect of father's occupation on respondent's educational attainment, (iii) that the effect of father's occupation on respondent's occupation is not affected by measurement error, and (iv) that the effect of respondent's educational attainment on occupational status is larger than a model without controls for measurement error suggests. Thus, Model 4 with the imputed error variances arrives at exactly the same conclusions as the models with explicit controls for measurement error. Modeling about 25% error variance in social background indicators and 15 and 20% in educational and occupa-

tional achievement, respectively, changes our view on the status attainment process in the Netherlands considerably.

7. Conclusion and Discussion

In this article we have estimated models for random and correlated measurement error in the status attainment model for the Netherlands, using information on family background from three informants: the respondent, one of his/her parents, and one of his/her siblings.

We have found that the results based on the measurement error models deviate in several ways from earlier findings with respect to the status attainment process in the Netherlands. First, we found that the model that controls for random measurement error leads to a non-significant effect of father's occupational status on his children's educational attainment, and to a larger effect of father's educational attainment on his children's education. This is in line with earlier conclusions, that in the Netherlands the cultural dimension of social inequality is stronger for status attainment process than the economic dimension, although it is surprising that the effect of father's occupation on children's educational attainment disappears completely in models in which measurement error is controlled for. Father's occupational status is based on both the average income of the occupation and the average educational attainment obtained by those who perform that occupation. Since we hold constant for father's educational attainment, father's occupational status can be considered to represent the economic dimension of family background. We now must conclude that the economic dimension does not matter in the Dutch educational system. The fact that previous research did find an effect of father's occupational status in the Netherlands is probably due to insufficient control for father's educational attainment, caused by measurement error. A second important conclusion is that in the Netherlands the effect of educational attainment on occupational status is stronger than models without correction for random measurement error suggest. We further did not find evidence that the information respondents provide about father's occupational status and father's educational attainment are systematically biased in the direction of their own occupational status and educational attainment. In addition, controls for correlated error do not lead to different estimates of the effects of the status attainment model.

We have shown that the correct path coefficients can be estimated by imputing explicit values of the error variances in the status attainment model. The error variances in both father's educational attainment and father's occupational status must be constrained to be about 25% of the original variances, and the error variances in respondent's educational attainment and occupational status must be constrained to be 15 and 20%, respectively, of the original variances. When these error variances are imputed in the model,

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Appendix The covariance matrices used

(R) = information obtained from respondent

(P)=information obtained from parent

(S) = information obtained from sibling

	1.	2.	3.	4.	5.	6.
Covariance Matrix						
Total group ($n = 3138$)						
1. birth year (R)	70.697					
2. female (R)	0.046	0.250				
3. educational attainment father, resp. aged 15 (R)	4.658	-0.005	11.272			
4. occupational status father, resp. aged 15 (R)	9.246	0.205	32.539	265.027		
5. educational attainment respondent (R)	3.790	-0.129	4.345	16.610	10.429	
6. occupational status respondent (R)	2.712	-0.768	15.737	77.115	27.991	256.544
Covariance Matrix						
Group A ($n = 226$)						
1. birth year	53.502					
2. female	-0.510	0.250				
3. educational attainment father (R)	5.365	-0.071	10.967			
4. educational attainment father (P)	4.793	-0.055	9.498	12.692		
5. educational attainment father (S)	5.129	-0.015	9.037	10.176	11.708	

Appendix continued

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9. educational attainment respondent (R)	2.523	-0.135	4.579	5.053	0.000	20.454	24.738	0.000	11.609	
10. occupational status respondent (R)	5.409	-0.385	17.955	19.217	0.000	98.160	112.941	0.000	30.378	279.381
Means	21.068	0.484	10.416	9.876	0.000	48.242	48.292	0.000	12.571	53.137
Covariance Matrix	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Group C ($n = 336$)										
1. birth year	76.768									
2. female	0.258	0.251								
3. educational attainment father (R)	3.749	0.016	12.041							
4. educational attainment father (P)	0.000	0.000	0.000	1.000						
5. educational attainment father (S)	5.340	0.109	9.266	0.000	10.940					
6. occupational status father, resp. aged 15 (R)	14.381	0.788	35.110	0.000	35.460	295.017				
7. occupational status father, resp. aged 15 (P)	0.000	0.000	0.000	0.000	0.000	0.000	1.000			
8. occupational status father, resp. aged 15 (S)	10.363	0.977	35.915	0.000	36.903	231.396	0.000	294.849		
Covariance Matrix	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Group C ($n = 336$)										
9. educational attainment respondent (R)	5.148	-0.050	5.265	0.000	4.482	23.350	0.000	20.559	10.997	
10. occupational status respondent (R)	12.420	-0.863	19.614	0.000	18.415	94.522	0.000	91.556	29.784	277.680
Means	16.411	0.503	9.146	0.000	9.080	45.185	0.000	45.685	11.655	49.438

Appendix continued

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Covariance Matrix										
Group E ($n = 464$)										
1. birth year	46.807									
2. female	0.204	0.250								
3. educational attainment father (R)	2.365	-0.104	11.164							
4. educational attainment father (P)	3.236	-0.086	9.240	11.777						
5. educational attainment father (S)	0.000	0.000	0.000	0.000	1.000					
6. occupational status father, resp. aged 15 (R)	3.978	0.276	31.011	34.994	0.000	251.693				
7. occupational status father, resp. aged 15 (P)	0.000	0.000	0.000	0.000	0.000	0.000	1.000			
8. occupational status father, resp. aged 15 (S)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000		
9. educational attainment respondent (R)	0.543	-0.118	3.134	3.727	0.000	14.293	0.000	0.000	8.921	
10. occupational status respondent (R)	-10.033	-0.971	9.807	10.448	0.000	53.032	0.000	0.000	23.583	240.923
Means	24.116	0.511	10.131	9.903	0.000	46.246	0.000	0.000	12.328	51.205
Covariance Matrix										
Group D ($n = 1951$)										
1. birth year (R)	69.219									
2. female (R)	-0.021	0.250								
3. educational attainment father (R)	3.699	0.022	10.647							

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the model estimates are very similar to those we found in the multi-informant model. We have made clear that this has consequences for conclusions about the status attainment process in the Netherlands, especially since not only the absolute sizes, but also the relative size of the effects are different in a model with controls for measurement error. After taking measurement error into account, the role of father's educational attainment is more important, especially compared to the role of father's occupational status.

Notes

1. In the 1998 survey, siblings have not been questioned about their parents.
2. The MBO gets a score that is somewhat lower than the actual years necessary to complete the education, since this type of education is less advantageous than other types with the same number of years.
3. The covariance and means matrices for the five groups are shown in Appendix.
4. In addition, the number of degrees of freedom as computed by LISREL must be corrected. The real number of degrees of freedom is 110 lower than computed, because 110 is the total number of values set to zero or one in the covariance and means matrices of the five groups (Jöreskog and Sörbom, 1996).
5. We computed the significance with the formula: $T = (b_1 - b_2) / \sqrt{(se_2^2 - se_1^2(se_2^2/se_1^2))}$, where b_1 and b_2 are the unstandardized regression coefficients, se_1 and se_2 are the standard error of the regression coefficients, and se_1^2 and se_2^2 are the unexplained variances in the dependent variables (Clogg et al., 1995).

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