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Analysing the Effect of Educational Differences between Partners: A Methodological/Theoretical Comparison

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Abstract: The effect of educational differences between partners on marital quality and stability is commonly analysed using difference, or compound measures. This article considers the theoretical foundations for these approaches and examines an alternative approach, diagonal reference models (DRMs). The three methods are then compared empirically, using data on 629 married couples from the survey *Child-Rearing and Family in the Netherlands*. Difference measures show no effect on marital satisfaction, whereas compound measures and DRMs do show an effect. As DRMs also allow for the quantification of this effect, while being theoretically and methodologically appropriate, they are affirmed the best method.

Introduction

In the past decennia, the social sciences have seen a clear increase in the availability of large multi-actor data sets. This has spurred interest in studying not only individual level, but also dyadic- and group-level effects. With this incorporation of multi-actor questions, a new type of effect was brought into the analysis. In addition to the effect of individual characteristics, the effect of dyadic/group characteristics and of the interplay between the individual and dyadic/group-level had to be considered. As this has led to the development of a new array of variables and analysis techniques, it has also affected the methodological consistency and the comparability of results in the field.

A clear illustration of this is research examining the effect of educational differences between partners on marital quality and stability. Two types of measures have generally been used to analyse the effect of educational differences: difference measures, and compound measures. Whereas the former assess the effect of the difference in education between partners, the latter compare the effects of all possible combinations of the education of the man and woman. Thus, these measures represent different operationalizations of the same concept of educational differences. In addition, a commonly used difference measure, *difference scores*, has been criticized on methodological grounds (e.g. uncontrolled confounding; see Edwards, 1994; Zuckerman *et al.*, 2002). Part of the results concerning the effect of educational differences is, in other words, open to discussion. Taken together, these issues illustrate the problems related to a lack of consensus concerning how to analyse the effect of educational differences.

This study will try to deal with these issues by comparing the commonly used measures for studying the effect of educational differences between partners on marital quality and stability. In addition, an alternative method will be examined stemming from mobility research, Diagonal Reference Models (DRMs). The commonly used measures will be compared to this alternative method; theoretically, by reviewing the specific features and (dis)advantages, and empirically, by comparing the results they generate using the same set of data. The goal is to compare the methods for analysing the theoretical question at hand and accordingly, allow for more methodological consistency and a clear conclusion concerning the effect of educational differences.

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Different Measures

The approaches to research on educational differences between partners can be located largely within two theoretical perspectives—heterogamy theory (e.g. Jorgensen and Klein, 1979; Tynes, 1990) and micro-economic specialization theory (e.g. Vannoy and Cubbins, 2001; Jalovaara, 2003). Each perspective relies on different theoretical premises, while aiming to uncover the way in which educational differences affect the quality and stability of relationships.

Heterogamy theory considers socio-demographic differences (e.g. differences in age, education) to be detrimental to relationships, as such differences are believed to heighten the risk of divorce and lower marital satisfaction (Kalmijn, de Graaf and Janssen, 2005; Amato *et al*., 2007). This effect of heterogamy is ascribed to two factors, namely cultural differences in, and lack of social support for heterogamous couples. Micro-economic specialization theory asserts that the gain from marriage is largest when partners are alike for traits that are complements, but different for traits that are substitutes (Becker, Landes and Michael, 1977; Becker, 1981). Substitutes are traits that are a proxy for household production, such as wage rates (Becker, 1973: 841). Education has commonly been considered a substitute, given its association with employment and wage rates (e.g. Tzeng and Mare, 1995; Heckert, Nowak, and Snyder, 1998)—even though Becker himself categorized it as a complementary trait. Thus, heterogamy theory sees educational homogamy as the best guarantee for relationship success whereas micro-economic specialization theory sees educational differences as positive, at least if the partner with the competitive advantage, typically the male, has the higher level of education.

Heterogamy theory and micro-economic specialization theory share a common interest, though with differing expectations. In addition, they share the diversity of ways in which they have analysed the effect of educational differences in couples. This variation extends from the selection of control variables—a (mainly) theoretical choice—to the way they have accounted for the effects of education, and differences in education.

Within these theoretical perspectives, educational differences have been mainly analysed using two types of measures: difference measures and compound measures (Table 1).

Difference measures are more commonly applied. Here, the educational difference is considered by one or more variables indicating its presence, and commonly also its direction and size. These variables either measure the absolute numeric difference, or capture the difference using categorical variables.

The absolute numeric difference variables quantify the absolute difference, in years or levels of education, between the man and woman. Accordingly, they denote both the presence and the size of the educational difference. In order to incorporate the direction of the educational difference, a dummy variable can be added that differentiates between couples in which the man is the higher educated, and couples in which the woman is the higher educated.

Categorical difference variables generally reduce the information concerning the size—and in certain cases the direction—of the educational difference. This is most obvious when only two categories are used, namely similar and dissimilar couples. Most studies, however, define (a minimum of) three categories: similar couples, couples in which the woman is the higher educated, and those in which the man is the higher educated. Hence, both the presence and the direction of the educational difference are generally taken into account, but less the size.

The second type of measures, compound measures, differentiates between the various combinations of the education of the man and woman and accordingly, incorporates both the effect of education, and the effect of differences in education. These measures most often use a limited number of educational categories, in order to reduce the number of educational combinations (e.g. three categories of education, which result in nine educational combinations). If the education of the man and woman is included before considering the effect of this measure, the compound measure can be considered an interaction term. Accordingly, it can be used to examine whether the interaction between the education of the man and woman significantly adds to the main effects of education. Even without such extra controls, these measures still differ from difference measures because the main effects of education are per definition incorporated in the compound measures.

Table 1 summarizes the diversity of measures used in studies examining the effect of educational differences between partners. However, the choice of methodology does not reflect the different expectations of research concerning heterogamy and micro-economic specialization theory. For example, heterogamy theory assumes an effect of the presence, and possibly also the size of the educational differences, and thus should be tested by means of a two categories difference variable or an absolute numeric difference variable without a direction dummy. On the other hand, research based on micro-economic specialization theory believes that the direction of the educational difference is also of importance, and should therefore incorporate a three (or more) categories difference variable, or an absolute

Table 1 Overview of the different types of commonly used measures

Difference measures
Absolute numeric difference variable
(e.g. years education man—years education woman)
→ Without a direction dummy
(e.g. Weisfeld *et al.*, 1992; Tzeng and Mare, 1995; Watson *et al.*, 2004; Clarkwest, 2007)
→ With a direction dummy
(e.g. Bitter, 1986; Janssen and de Graaf, 2000; Janssen, 2001)
Categorical difference variable
(e.g. three categories: homogamy/education man > woman/education man < woman)
→ Two categories
(e.g. Tzeng, 1992; Houts, Robins, and Huston, 1996; Gong, 2007)
→ Three or more categories
(e.g. Tynes, 1990; Bumpass, Martin, and Sweet 1991; Janssens *et al.*, 1999; Heaton, 2002; Schoen, 2002; Goldstein and Harknett, 2006;)

Compound measures
Compound variable as such
(e.g. nine categories: both man and woman low education/man low, woman average education/etc.)
→ Four categories
(e.g. Rogler and Procidano, 1989)
→ Nine categories
(e.g. Jalovaara, 2003; Charles and Stephens, 2004; Lyngstad, 2004; Kraft and Neimann, 2009)
→ Sixteen categories
(e.g. Bumpass and Sweet, 1972)
Compound variable as interaction term
(e.g. Finnäs, 1997; Vannoy and Cubbins, 2001)

numeric difference variable with a direction-dummy. Yet, such a clear differentiation in the choice of variables cannot be made in the studies included in Table 1. In addition, the use of difference and compound measures has not been differentiated theoretically or empirically. Hence, research concerning the effect of educational differences on marital quality and stability appears to be characterized by a lack of methodological and probably conceptual unity. This can be problematic, given the clearly differing ways in which the different variables and measures have operationalized, and analysed the effect of educational differences.

Theoretical Comparison of Difference and Compound Measures

When considering the use of difference measures, one cannot help but notice the abundant literature that explicitly criticizes it. Particularly in the psychology literature, the use of non-categorical difference variables (*difference scores*) has been frequently opposed. The problems have been extensively described in the literature (Edwards, 1995, 2002; Griffin, Murray and Gonzalez, 1999; Cheung, 2009), so only a brief overview will be given here.

The most common objection to difference scores concerns the presumed reduced reliability of this type of measure. When two components are positively correlated—as is normally the case with the educational attainment of partners—the reliability of the variable measuring their difference is usually lower than that of either components.[1] Since it leads to a loss of statistical power in the analysis, such lowered reliability can be considered detrimental.

In addition, difference measures are frequently viewed as being conceptually ambiguous. Although the components are commonly believed to contribute equally to the difference measure—given their equal unity—this is in reality often not the case. The reason for this is that the variance of a difference score is not only determined by the unity of its components, but also by their variances and covariances—which are sample specific. This becomes obvious when looking at the typical example of a sample in which the educational level of the men varies while that of the women is a constant. In that case, the difference measure will be nothing more than a rescaled version of the educational variable of the men. Thus, difference measures can conceal substantial differences in the effects of the components and lead to serious confounding and misinterpretation of their

effects (e.g. Griffin *et al.*, 1999: pp. 512–513; Edwards, 2002: p. 355).

Difference measures also impose certain constraints on the model, most often without testing their validity. That is to say, the effect of a difference measure is by definition constrained by the effects of its components.[2] This is believed to be detrimental in terms of the variance explained by the difference measures, since '. . ., a model imposing this constraint cannot explain more variance than a model that simply contains both composites as separate predictors'. (Edwards, 1994: p. 61). In accordance with this, it becomes clear why controlling for confounding by including the effects of both components will not bring solace, as it will lead to high correlations between the variables for education, and educational differences (multicollinearity). Stated differently: '. . . it is impossible to hold constant the characteristics of both spouses while letting the differences between them vary.' (Glenn, Hoppe and Weiner, 1974: p. 524).

A final critique of difference measures is that they reduce an inherently three-dimensional relationship or multivariate model to a two-dimensional relationship or univariate model. For example, because they synthesize all (educational) differences to one number, difference measures do not allow for a theoretical differentiation between a 1 year/level educational difference at different levels of the educational ladder. This dimensional constraint illustrates that difference measures do not allow a correct representation of the studied relationships.

Although these critiques are generally leveled at numeric difference measures, they apply to categorical difference measures in a similar vein, since these are essentially a condensed form of difference measures. Moreover, this condensed form creates an extra disadvantage, that is, a loss of information. In brief, both types of difference measures are subject to fundamental criticism. Therefore, to question if difference measures can still be used for studying the effect of educational differences seems more than legitimate.

Given the aforementioned shortcomings of difference measures, the question is whether the use of compound measures is more suitable. While less commonly used, the compound measures do appear to address most of the critiques of difference measures. This is because compound measures combine both the effect of education as well as the effect of educational differences into one categorical variable. Therefore, the problems associated with the difference measures such as confounded effects do not extend to these measures.

Unfortunately, compound measures are not free of limitations either. They often necessitate a substantive reduction of the available information. Although the categorical variables are intended to represent all possible combinations of the education of the man and woman, the exponential number of possibilities typically requires the merging of educational categories. Even with such mergers, extreme categories usually suffer from small representation, a drawback that can only be avoided by using a large data set, as in the studies of Jalovaara (2003) and Lyngstad (2004).

In addition, compound measures can also hinder clear conclusions about the presence of a (significant) effect of educational differences. Since compound variables do not distinguish between the effect of education, and the effect of educational differences, it is impossible to determine what proportion of the total variance explained by the compound variable is due to educational differences. Furthermore, this type of categorical variable does not allow for quantification of one or multiple effects of educational differences. In sum, clear conclusions about the significance and the exact nature of a possible effect of educational differences are not always straightforward when using compound measures. This is especially the case when the total effect is small in magnitude and diverse in nature.

When the compound variable is modelled together with both educational variables (a technique suggested by Duncan 1966; Blau and Duncan, 1967), the situation changes. The compound variable is then equivalent to an interaction term that tests whether a significant portion of the variance in the dependent variable can be explained by patterns deviating from the effect of education. Although this method appears straightforward, some authors have asserted that it does not provide clear interpretations, since it is an 'unwieldy criterion' (Sobel, 1981: p. 894) that requires 'graphing the interaction' and 'carefully evaluating its meaning' (Luo and Klohnen, 2005: p. 305).

Studies on the related topic of social mobility have raised additional, more fundamental objections to the interaction method (Hope, 1971, 1975; Sobel, 1981, 1985). Since the degree of mobility is a linear combination of the two components, the interaction model is not believed to test for the presence of a mobility effect '. . . because it incorporates such an effect within its own variance'. (Hope, 1975: p. 332). Applying this criticism to educational differences means that the presence (or absence) of an interaction effect cannot be considered a valid indicator for the presence (or absence) of an effect of educational differences.

In addition, the interaction method is also contested on theoretical grounds. The main critique—applied to educational differences—is that this method compares the characteristics of educationally dissimilar couples

with those of the educational group of the man, and those of the educational group of the woman. A proposed alternative is that one should use the characteristics of the similar couples as a reference for the dissimilar couples, since similar couples can be seen as representing the *core* of the educational group. Since this cannot be done with the interaction method, this theoretical approach calls for the use of a different analysis technique.

DRMs

A theoretically founded technique (Cox, 1990; Yamaguchi, 2005) that could provide a valuable alternative, are the DRMs, originally named diagonal mobility models. DRMs were suggested by Sobel (1981, 1985) as a way of studying the effects of social mobility. In addition, this technique has been favourably judged in relation to other models for examining status inconsistency, and mobility effects (Hendrickx *et al.*, 1993).

DRMs appear suited for examining the effect of educational differences, as they offer a parsimonious and interpretable approach to analysing the simultaneous effect of both partners' (educational) position. These models have been frequently used to analyse the direct effect of (educational) mobility or status inconsistency (Sobel, 1985; de Graaf, 1991; Tolsma, de Graaf and Quillian, 2009; Daenekindt and Roose, 2011). In addition, these models have been applied to questions concerning the relative effects of status of origin and destination, an application which has commonly been extended to analyse the relative effects of both partners'—and sometimes also parents'—class or education on a number of class-related behaviours and values (de Graaf and Ganzeboom, 1990; Ultee and de Graaf, 1991; van Berkel and de Graaf, 1995; Van der Slik, de Graaf and Gerris, 2002; Monden *et al.*, 2003).

In analogy with Sobel, we can apply his technique to the idea that couples with a similar level of education represent the *core* of an educational group (cf. 'Theoretical Comparison of Difference and Compound Measures' Section). Since both partners share the same educational level, they are indeed not subject to the influence of another educational group through their spouse. When cross-tabulating the education of the man by the education of the woman, similar couples can be considered *diagonal referents* for couples that are located off the diagonal. The off-the-diagonal couples are the couples with differing educational levels. Their position in the table means that their characteristics can be expected to lie in-between those of the corresponding similar couples. Each dissimilar couple with educational levels i and j is thus determined by the values of two similar couples—namely, the diagonal values μ_{ii} and μ_{jj}. The relative impact of these diagonal referents, and thus of the education of the respondent and partner, is estimated by two *salience parameters*—p and q—that sum up to 1:

$$Y_{ijk} = p^*\mu_{ii} + q^*\mu_{jj} + \varepsilon_{ijk}; \quad i = 1,\ldots,T; j = 1,\ldots,T; k = 1,\ldots,n_{ij} \tag{1}$$

The baseline model describes the value of the dependent variable Y_{ijk} as a function of both spouses' educational levels (i and j), complemented by a stochastic error term with expected value 0. Since this model does not yet incorporate the effect of educational differences, different types of such effect can be added [in (2): w different variables D]. Hence, it is possible to test for deviations from the effects of the educational variables or—in other words—to test for an effect of educational differences over and above the educational effects. Similarly, covariates can be added to the equation [in (2): l different variables X]. This means that, for example, control variables can be easily included in the models. The extended DRMs, therefore, are said to combine the advantages of log-linear models (analysing non-linear and interaction effects), with the flexibility of multivariate regression (incorporating multiple control variables) (de Graaf and Heath, 1992: p. 313).

$$Y_{ijk} = p^*\mu_{ii} + q^*\mu_{jj} + \sum \beta_w^* D_{ijw} + \sum \beta_1^* X_{ijl} + \varepsilon_{ijk}; \quad i = 1,\ldots,T; j = 1,\ldots,T; k = 1,\ldots,n_{ij} \tag{2}$$

DRMs answer the two main critiques by Hope and Sobel of the interaction method (cf. 'Theoretical Comparison of Difference and Compound Measures' Section). In addition, the technique has extra features that are beneficial for analysing the effect of educational differences. Because of their flexibility, the models can test for different types of dissimilarity effects. Hence, they allow for a clear comparison of, for example, heterogamy and specialization effects. In addition, the models do not require any assumption about the order of the categories. This means that this technique is capable of testing dissimilarity effects stemming from differences in, for example, nominal characteristics as religion or ethnicity. Lastly, DRMs are adjusted to studying dyads, rather than individuals. As a result, they lend themselves to research questions located at the couple level. Thus, DRMs not only offer an answer to common critiques, but also specific advantages. They appear to be the best fitting method for analysing the effect of educational differences.

Aim of the Analysis

Thus far, three methods for analysing the effect of educational differences have been identified and compared theoretically. The objective of the analysis will be to examine the effect of educational differences on marital satisfaction. The results from the DRMs will be contrasted with those from the two common methods in order to empirically compare the three methods using one data set.

Method

Data

The comparison of methods will be based on cross-sectional data from the survey *Child-Rearing and Family in the Netherlands*. The focus of this data from 1990 is the functioning of family relations in the Netherlands (Gerris *et al.*, 1992). The central aim of this national survey was to study the relationship between environmental factors and the internal functioning of the family.

The selection of families for the survey was based on a multi-stage method. In the first stage, a selection of Dutch municipalities, distinguished by regional zone and degree of urbanization, was made. Within these selected municipalities, a random sample of 9 to 16-year-old children who live with their parents was taken. In most cases, these parents were married (90.3 per cent) and had 1–3 children (mean = 2.5, SD = 1.0, max = 12). The average marital duration was high (17.2 years, SD = 3.7), whereas parents age ranged from 27 to 65 years (mean = 42.4, SD = 5.0) for the men, and 26 to 54 years (mean = 40.0, SD = 4.3) for the women. Most of the spouses were born in the Netherlands (95.1 per cent), and specified their religious group membership as catholic (41.8 per cent) or protestant (27.3 per cent) (approximately 1 per cent unknown and remainder did not belong to a religious group). The socio-economic characteristics of the sample were heterogeneous with 9.5 per cent of individuals (♀/♂: 4.1/14.7 per cent) performing unskilled jobs, 13.9 per cent (17.9/10.1 per cent) skilled jobs, 37.0 per cent (23.6/49.9 per cent) lower technical/managerial jobs, 9.2 per cent (12.9/5.7 per cent) small trade jobs, 15.7 per cent (22.5/9.2 per cent) mid-level technical/managerial jobs, and 14.7 per cent (19.0/10.5 per cent) higher professions.

The final sample of 788 families was questioned using both structured interviews and questionnaires. Accordingly, demographic information as well as information about attitudes and family relations were gathered. Both child and parents were questioned, which results in a unique multi-actor perspective. The response rate of 43 per cent is comparable with that of other Dutch surveys, such as the Netherlands Kinship Panel Study (Dykstra *et al.*, 2005).

Selection of Families and Variables

In the analysis, we examined a subset of the families included in the survey. We excluded non-married couples (89 families) due to their small number in the sample and the possibility of them having less stable relationships. We also excluded families in which one or both partners were born outside the Netherlands (55 families). This was done to reduce heterogeneity on non-studied factors (e.g. ethnic differences). Finally, 15 families were not included in the analysis due to incomplete information on education (1 family) or marital satisfaction (14 families). Thus, our final sample consisted of 629 families, 79.8 per cent of the original sample.

The main 'independent variable' in the analysis is the *educational difference* between partners. Although the operationalization of this variable differs depending on which of the three methods is tested, all variables are based on information concerning the highest level of education attained by both partners. This highest attained educational level is measured by means of eight categories, namely: (i) less than elementary school ($N_{♀/♂} = 16/9$); (ii) elementary school ($N = 36/80$); (iii) lower technical and vocational training ($N = 200/185$); (iv) lower general secondary education and the first three classes of the higher general secondary and pre-university education ($N = 83/137$); (v) intermediate vocational education ($N = 107/113$); (vi) upper school of the higher general secondary education and the pre-university education ($N = 45/36$); (vii) higher vocational education ($N = 78/51$); and (viii) university education ($N = 64/18$).[3] In addition to being used to determine educational differences, these educational categories were also used as separate variables that controlled for the *educational effects* in the analysis.

The 'dependent variable' is the level of *marital satisfaction*. This variable is based on reports from the man concerning the degree to which he experiences the marital relationship with his partner as satisfying and positive (seven items); e.g. 'I did expect more of the relation with my partner', 'In fact it is my opinion that the relation with my partner should be improved'. The answers to the questions are measured using a 7-point Likert scale ranging from 1 'Not at all applicable to me' to 7 'Very applicable to me'. With a Chronbach's α of 0.80, the reliability of the scale can be considered good (mean = 6.08; SD = 0.95). This internal consistency, and

the construct validity of the scale, have already been validated by previous research (Gerris *et al.*, 1993; Van den Troost *et al.*, 2005).

In addition to the independent and dependent variables, 'control variables' are taken into account. The following, commonly used control variables are entered in the analysis: *period of the marriage* (1970 or earlier/after 1970), *marriage duration* (in years), *age at marriage of the man* and *age at marriage of the woman* (in years), *number of children*, *age of the youngest child* (in years), *employment situation of the woman* (number of paid working hour), *household income* (≤€2100; €2100–€3250; €3250–€4500; >€4500), and *religiousness of the man* and *religiousness of the woman* (not a member of a Christian church or religious community/a member and visits a couple of times a year–month). All these variables have been centered or effect coded in order to compare the effect of education(al differences) for the 'average couple'. Missing values on the control variables have been imputed [Multiple Imputation, five imputations (Fully Conditional Specification)], so as to retain the maximum number of cases in the analysis.

Analyses Technique

The analyses will compare the three methods for studying the effect of educational differences. The use of difference and compound measures was tested by means of linear regression analysis. The third method covers the diagonal reference models, which were estimated by means of the Non-Linear Regression command in SPSS.

Starting with the difference measures, the analyses were built in stages starting with a model containing no educational variables and progressing through models containing the education of the man, the education of the woman, the education of the man and woman, and then the mean education of the couple. In the first analysis, the effect of the absolute numeric difference in education was determined after adjusting for the educational variables. The second analysis included a variable indicating the direction of this difference, to differentiate between couples in which the man is the higher educated, and couples in which the woman is the higher educated. In the next three analyses, we used the categorical difference measures. Three different categorizations were examined: a dichotomous variable (no difference/difference), a three-category variable (no difference/woman higher educated/man higher educated), and a five-category variable (no difference/woman 1–2 categories higher educated/man 1–2 categories higher educated/woman ≥3 categories higher educated/man ≥3 categories higher educated).

The results of the five regression analyses for the difference measures were compared to the regression results for the compound measures. The possible effect of differences in categorization was taken into account by using two types of compound measures. First, the categories of the educational variables were reduced from eight to three (aggregating categories 1–2, 3–5, and 6–8). These aggregated variables yielded nine possible combinations of the education of the man and woman. Alternatively, a four-category aggregation (aggregating categories 1–2, 3–4, 5, and 6–8)—yielding 16 possible combinations of the education of the man and woman—was examined.

Finally, the DRMs were contrasted with the two linear regression methods. By evaluating the fit of different models, this method tested effects of educational differences analogous to the effects tested for the difference measures. The first two tested the effects of the signed, and the absolute difference in educational levels. The remaining three tested three categorical difference variables that allocated the couples to two, three, or five categories respectively. This (re-)examination of the commonly studied effects completed the comparison of three methods.

Results

Exploratory Analysis

Before turning to the results for the different methods, the educational effects will be explored by examining the average level of marital satisfaction according to the education(al combinations) of the man and woman.

The education of the men shows a non-linear association, as the middle-educated men distance themselves from the higher and lower educated men because of their higher reported marital satisfaction (last column of Table 2). These differences are significant ($F_{2,626} = 10.73$, $P < 0.001$), and confirm a previous observation of Wagner (1997; Kraft and Neimann, 2009: p. 14), who found that the positive association between education and divorce risk changes when examining more segmented analyses, since such analyses reveal that the risk of divorce is heightened for individuals with both a very low, and a very high level of education. For the women, a different, linear pattern is apparent. The marital satisfaction as reported by the men is inversely related to the level of education of the women (last row of Table 2; $F_{2,626} = 4.01$, $P < 0.02$).

Whereas the association with the education of the man and woman appears rather incoherent, a clearer pattern can be found when exploring the link with the educational differences between partners. This is done by

Table 2 Mean of man's marital satisfaction according to the education(al combinations) of the man and woman[a]

Education man	Education woman			
	Low	Middle	High	Mean
Low	**5.81**	5.76	5.53	5.76
Middle	6.29	**6.21**	5.99	6.21
High	6.49	5.91	**5.84**	5.89
Mean	6.23	6.10	5.86	6.08

[a]*Based on the aggregated classification (categories 1–2, 3–5, and 6–8).*
(Light) grey = mean level of marital satisfaction is below (above) the mean levels of both similar counterparts.
Bold = means for the similar couples.

comparing the mean level of marital satisfaction for every dissimilar couple to that of its similar counterparts (scores in bold). For example, heterogamous couples in which the man and woman are located in educational categories 'Low' and 'Middle', respectively, have to be compared to the homogamous couples in which both partners are in the educational category 'Low' and the homogamous couples in which both partners are in the educational category 'Middle'.

The comparison shows that dissimilar couples have a mean that, for the most part, differs from the mean scores of the similar counterparts (4/6 cells are grey). In couples where the woman is the higher educated, men tend to display a lowered marital satisfaction. In couples where the man is the higher educated, a reverse pattern can be discerned, as the mean marital satisfaction of the men is higher than expected, based on the scores of the similar counterparts. While this pattern appears in line with the expectations of micro-economic specialization theory, the overall small differences in marital satisfaction, combined with the possible role of disturbing variables needs to be kept in mind.

Educational Differences and Marital Satisfaction: A Comparison of Methods

When now turning to the results for the three methods, we can compare the specific answer they provide to the theoretical question at hand. An overview of the results for all three methods will first be given, after which we will conclude with a comparison of these results.

The use of difference measures is examined by entering as independents in separate linear regression analyses the five difference variables that have been commonly used to test the heterogamy and micro-economic specialization hypothesis (cf. 'Analyses Technique' Section).[4] The results of the various analyses are rather consistent; both the two analyses for the numeric difference variables, and the three analyses for the categorical difference variables do not show any significant improvement in fit when adding the effect of the difference variable(s) (Table 3). This means that neither the heterogamy hypothesis, nor the micro-economic specialization hypothesis is supported when using difference measures.

As these results extend to all parallel models, controlling for the education of the man and/or woman does not appear to matter here. Thus, the problem of confounded effects, that is commonly associated with difference measures, cannot be confirmed—though the lack of any effect of educational differences means it cannot be refuted either. The results do point to another problem, multicollinearity, which is linked to analysing the effects of both education, and educational differences. The elevated values for the Variation Inflation Factor (VIF)—which go up to 22.4 (data not shown)—clearly illustrate that the possibility of confounded effects cannot be successfully prevented by controlling for the education of both the man and woman in the analysis.

To conclude, the pattern that was observed in the exploratory analysis is not confirmed when using difference measures, as they fail to show any significant effect of educational differences. In addition, this lack of effect does not allow a clear examination of the alleged problems of the difference measures, although the problem of multicollinearity does arise when controlling for the education of both the man and woman in the analysis.

When replacing the difference measures in the linear regression analyses by compound variables, and thus adopting the second method for analysing the effect of educational differences, results can be compared to those for the first method. Two kinds of compound measures are tested; one that is based on the three-category educational variables, and one that is based on the four-category educational variables (cf. 'Analyses Technique' Section). Again, the impact of controlling for the educational effects is examined (see note 4).

When educational effects are not controlled for, both compound measures display a significant effect ($\Delta R^2_{9\text{-cat}/16\text{-cat}} = 0.04/0.05$, both $P < 0.02$). This means that the 9- and 16-category variables support the idea of an educational effect on the marital satisfaction as reported by the man. What this means in terms of the effect of educational differences is however more difficult to assess. Because no specific effect is tested by the compound measures, one has to fall back on searching for a pattern in the regression coefficients to answer this question. As was already stipulated in the description for

Table 3 Change in R^2 for the models using the difference measures

Included variables	No educational variables	Education man	Education woman	Education man and woman	Mean education couple
Absolute difference	0.001	0.002	0.002	0.001	0.000
Abs. diff. plus direction	0.001	0.005	0.002	0.001	0.002
Two categories	0.000	0.001	0.000	0.001	0.000
Three categories	0.001	0.004	0.001	0.001	0.002
Five categories	0.007	0.006	0.006	0.004	0.007

Table 2, a pattern does emerge that is in line with the micro-economic specialization hypothesis.

The compound measures do not test the significance of an effect of educational differences. They do test for such an effect, when being supplemented with the educational variables. This common alternative method corresponds to examining an interaction effect, and is shown to be insignificant here ($\Delta R^2_{\text{9-cat/16-cat}} = 0.00/0.01$, both n.s.). Whether this means that the existence of any effect of educational differences can be rejected, is unclear. This situation illustrates the common critique that it is not well specified which effect is tested by this method.

Depending on how they are used, the compound measures either confirm the effect of educational differences as found in the exploratory analysis (parallel models without controls for education), or reject the idea of a significant effect (parallel models with controls for education). This divergence illustrates the limitations of the compound measures (cf. 'Theoretical Comparison of Difference and Compound Measures' Section); while the former application only allows an inspection of the possible pattern without testing its significance, the latter does allow such a test, but with little clarity about the specific pattern that is tested. As a result, neither permits definite conclusions about the presence of an effect, even though the compound measures do give a clear idea about the present pattern; however, usually for the aggregated educational categories only.

The last method that needs to be considered is the use of diagonal reference models. In Table 4, a baseline model containing only the education of the man and woman, is compared to five models containing different variables that test the heterogamy, or micro-economic specialization hypothesis.[5] The differences in R^2 indicate that the model for the *signed difference in educational levels* fits both significantly better than the baseline model and better than the other 'educational difference models'. This is the case irrespective of the categorization of the educational variables (eight, four, or three categories) used in the models.[6]

The level of marital satisfaction as reported by the man is affected by the size, and the direction of the educational difference. This is to the advantage of couples in which the man is the higher educated, as the *signed difference in educational levels* (SD) shows a positive coefficient (Table 5). Specifically, the expected score of men in marriages where the woman has the highest and the man the lowest educational level, is more than three-quarters of a point ($b = 0.06$; $0.06 * 14 = 0.84$) lower than that of men in marriages where the man has the highest and the woman the lowest educational level as indicated by the eight-category solution.

Thus, the results for the DRMs confirm the expectations of micro-economic specialization theory. As was suggested by the exploratory analysis, the level of marital satisfaction is shown to be significantly affected by the size, and the direction of the educational difference.

With the results of the three methods at hand, we can finally compare the answer they provide concerning the effect of educational differences.

We began our comparison with the results for the difference measures, which did not display any effect of educational differences. This lack of effect also meant that the alleged problems of the difference measures could only be partially examined (i.e. multicollinearity). Contrary to the difference measures, the compound measures did confirm the pattern found in the exploratory analysis. However, while displaying the existing association between the marital satisfaction of the man and the educational differences, these measures did not allow for testing of specific effects. When used as interaction term, they furthermore showed difficult to interpret. Thus, they failed to deliver a conclusive answer about the effect of educational differences.

Such an answer was available when using the alternative method, DRMs. The *signed difference in educational levels* was identified as the best fitting effect, and

Table 4 Model comparison for the DRMs, based on differences in R^2 (comparison to BM)

	Education—eight categories	Education—four categories	Education—three categories
BM			
+ effect of educational differences:	0.042	0.034	0.033
Signed diff. in educational levels	0.048***	0.039**	0.038**
Absolute diff. in educational levels	0.044	0.035	0.034
Two categories	0.042	0.034	0.033
Three categories	0.046	0.038	0.037
Five categories	0.048	0.041	0.040

BM, Baseline Model.
***P < 0.01; ***P < 0.001.*

Table 5 Results for the DRMs—comparison of BM and best fitting model[a]

	Education—eight categories		Education—four categories		Education—three categories	
	BM	+SD	BM	+SD	BM	+SD
Salience parameter						
P	0.92	0.95	1.00	0.94	1.00	0.97
Means (μ_{ii}s) for the homogamous with educational level *i*						
μ_{11}	5.69	5.83	5.76	5.84	5.76	5.85
μ_{22}	5.78	5.85	6.24	6.23	6.21	6.20
μ_{33}	6.29	6.30	6.15	6.14	5.89	5.81
μ_{44}	6.14	6.14	5.89	5.80		
μ_{55}	6.15	6.09				
μ_{66}	6.10	6.02				
μ_{77}	5.86	5.74				
μ_{88}	5.74	5.64				
Parameter estimates for the heterogamy variables						
Signed difference in educational levels		0.06*		0.12^{+}		0.12^{+}
R^2	0.042	0.048***	0.034	0.039**	0.033	0.038**

[a]*Model with signed difference in educational levels (SD).*
*$^{+}$P < 0.10; *P < 0.05; **P < 0.01; ***P < 0.001.*

confirmed the previously suggested association between the marital satisfaction and the size and direction of the educational difference. While this conclusion is similar to the one suggested by the conventional compound measures, DRMs also allowed for the examination of specific effects and accordingly provided a conclusive answer about the effect of educational differences.

Conclusion and Discussion

The importance of educational differences for the marital quality and stability has been the focus of research concerning heterogamy, and micro-economic specialization theory. This study took one step back by considering the more basic matter as to which method should be preferred for analysing the theoretical question concerning the effect of educational differences. The need for this was illustrated by the multiple and sometimes contested measures that have been used in previous studies. Focusing on this basic matter thus seemed essential to provide a way out of the methodological inconsistency and accordingly, allow for a clear conclusion concerning the effect of educational differences on marital quality and stability.

We started from the observation that essentially two types of measures have been used in past research: difference measures and compound measures. In the analyses, different variants of these measures were compared when used to study the association between

the educational differences and the marital satisfaction as reported by the man. The difference measures were judged most problematic, as they were characterized by serious theoretical and methodological problems (e.g. multicollinearity). Despite their being less commonly used, the compound measures offered better results. They confirmed the pattern as found in the exploratory analysis, without however allowing a conclusive answer concerning (the significance of) the exact effect of educational differences. When used as interaction term, they furthermore showed difficult to interpret. Thus, the drawbacks of the compound measures were largely confirmed.

As an alternative to the two commonly used measures, a third method was examined for studying the effect of educational differences. As theoretically grounded technique, diagonal reference models have been specifically developed for estimating the relative effects of two (or more) complementary, parallel influences (i.e. the education of the man and woman) on a dependent metric variable (i.e. the marital satisfaction). This technique also provides a tool for comparing complex couple effects in an easy and intuitive way.

In the analyses, the substantive compatibility of the DRMs led to a clear conclusion concerning the effect of educational differences: the model selection procedure showed the level of marital satisfaction to be associated with the size, and the direction of the educational difference. This result confirms the expectations of micro-economic specialization theory as it shows that men report the highest marital satisfaction in couples where they themselves are the higher educated, and the lowest marital satisfaction in couples where the woman is the higher educated. While this conclusion corresponds to the pattern as indicated by the compound measures, the results from the DRMs went further. The main reason for this is that this technique also allows for the determination of the significance of specific effects of educational differences, while being theoretically adjusted to studying this type of effects.

Results of this study support the expectations of micro-economic specialization theory, rather than those of heterogamy theory. This could be because results are based on a sample of Dutch couples with an average marriage duration of 17.2 years in 1990. That is, it is possible that more recent data would find more support for the value of homogamy, and less support for the value of a 'traditional' heterogamous marriage. While this conclusion is interesting from a theoretical point of view, it could matter for the comparison of methods as well. That is, in addition to the specifics of the used data (e.g. size of the sample, operationalization of education), the specific effect of educational differences in the data could have influenced the results that are generated by the methods. For example, in our study the alleged problem of the confounding of effects by the difference measures could not be confirmed. In addition, the lack of significant effects for these measures could be linked to the specific effect of educational differences in the data, or the somewhat small size of the studied sample. Nevertheless, we do believe that our theoretical and empirical comparison of methods convincingly illustrates the basic differences between the methods, and the value of the DRMs as an alternative technique to analysing the effect of educational differences. Future research could try to expand on these findings by using other data or, for example, by generating simulated data designed to focus on the specific problems/differences.

This article tried to advance research on educational differences by considering which method should be preferred to examine this type of effects. While the choice of method is essential, it does not tell the whole story either. Other aspects need to be considered as well, for example, the type of educational differences to be analysed. Whereas this study, in line with most past research, focused on differences in the level of formal education between partners, future research should question whether this is the best indicator or whether, for example, education in years, informal education, or specialization might be more informative. Even though the choice of indicator may depend on the context and question at hand, it should always be based on theoretical consideration.

Our comparison of methods started from a question concerning methodological inconsistencies, but ended with a technique that can be preferred from both a methodological and theoretical point of view. This clearly illustrates the inherent link between theory and methods, which causes any question concerning the best method for analysing the effect of educational differences to be a conceptual question about this type of couple effects as well.

At this conceptual level, the effect of educational differences has commonly been considered as an effect stemming from a difference between partners. Accordingly, it has been analysed by adding some type of difference variable to an additive linear model. While such a difference variable is inherently related to both partners' educational effects, the crucial question of how to model these educational effects has often been overlooked. Consequently, the use of additive effects for analysing the effect of educational differences has rarely been questioned.

However, as additive techniques are useful for studying individuals, dyadic techniques have been developed for studying dyads. Hence, they allow the educational

effects to be analysed at the couple level, and not just as individual additive influences. Moreover, dyadic techniques also open the way to specifying the effect of educational differences as a deviation from the pattern of educational effects as laid out by the similar couples, instead of by the general educational groups. Thus, dyadic techniques allow for testing of a different type of couple effects, one that is more compatible methodologically, and—in our opinion—from a conceptual point of view.

DRMs have been shown to be useful to the study of effects stemming from educational differences between partners. More generally, this technique can be used for a wide range of research questions at the dyadic level. In this study, the focus was on the direct effect of educational differences over and above the main effects of education. Yet, many other studies have shown how DRMs can be applied to questions concerning the relative effects of the characteristics of individuals as well (cf. 'DRMs' Section). In other words, DRMs offer the flexibility of analysing multiple types of research questions (e.g. concerning both direct and relative effects) over a variety of research domains that are of interest to social scientists (such as decision-making, attitude alignment, divorce, timing of childbirth, health behaviour). Hence, the future of this type of research might lie in the use of such dyadic techniques.

Notes

1. For a detailed explanation and formula, see Edwards (2002: pp. 352–353).
2. Edwards (2002: pp. 355–357) illustrated this by first rewriting the equation $Z = b_0 + b_1(X-Y) + e$ as $Z = b_0 + b_1X - b_1Y + e$ and then comparing it to the equation using both separate predictors of Z: $Z = b_1 + b_1X + b_2Y + e$. This illustrates that '... using an algebraic difference score as a predictor is equivalent to constraining the coefficients on X and Y ... to be equal in magnitude but opposite in sign ($b_1 = -b_2$).'
3. Because of small representation in category 8 ($N_{♀/♂} = 2/1$), the original categories eight (university education, bachelor's degree) and nine (university education, master's degree) have been aggregated.
4. Since the control variables did not lead to a significant improvement in fit ($P_R{}^2 > 0.10$), these variables are not included in the regression analyses.
5. A model including all 10 control variables was first compared to the baseline model. This model did not lead to a significant improvement in fit ($P_R{}^2 > 0.10$).
6. When the original eight educational categories are used, the two-, three- and five-category variables are analogous to the ones used as categorical difference variables, when only three or four educational categories are distinguished, the similar couples are differentiated from the couples with one or more categories difference or, for the five-category variable, from those with a difference of one versus more than one category.

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