

UNITED NATIONS
STATISTICAL COMMISSION and
ECONOMIC COMMISSION FOR
EUROPE

INTERNATIONAL RESEARCH AND
TRAINING INSTITUTE FOR THE
ADVANCEMENT OF WOMEN
(INSTRAW)

CONFERENCE OF EUROPEAN
STATISTICIANS

Joint ECE/INSTRAW/UNSD Work
Session on Gender Statistics
(Geneva, 20-22 April 1998)

Working Paper No. 24

MEASUREMENT OF BEHAVIORAL GENDER SEGREGATION ¹

Differences in time use between women and men

Paper submitted by Statistics Netherlands²

Summary: Analogously to occupational gender segregation behavioural gender segregation can be defined as disproportional performance of activities by women and men. Segregation indices appear very well applicable to behaviour as measured by time use surveys. The analysis might be directed to participation in separate activities as well as to the time spent on them. Application of the segregation measures to data for the Netherlands 1975-1995 shows plausible and very well interpretable results. Behavioural gender segregation in the Netherlands is decreasing. That conclusion appears particularly valid for productive activities.

Keywords: gender, segregation, time use, inequality

1. Introduction

1. The employment structure has become an important domain in the combat against inequalities between women and men in the labour market. One of the objects of growing attention in the last decade has been the occupational gender segregation which concerns the clustering of women and men in different occupations. Several techniques of measuring segregation have grown out of the efforts to deal with this subject.

2. Although separate daily activities have a totally different time dimension from occupations, they can also be described as a set of units having differential distributions of female and male participation. In this article various measures of occupational gender segregation will be applied to data on daily activities, as collected in time use surveys.

¹ The author wishes to thank the Social and Cultural Planning Office (SCP) for the use of the data from the Time Use Surveys and especially to Dono Niggebrugge for his efforts to make the data available. He is also very grateful to Jeroen Pannekoek for his methodological advice and comments.

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3. In the next section of the article the relationship between occupational segregation and segregation in daily activities will be examined more closely. This will be followed by a section on the measurement of segregation in which the procedure, recommended by Blackburn e.o. (1995), to compute segregation indices will receive special attention. The introduction of the time use surveys that were the sources of our data precedes the sections in which the results of the application of segregation measures on the time use data will be presented. A synopsis of the findings and a discussion on their implications and on future perspectives will form the last section of the article

2. Gender oriented segregation in the domain of time use

4. The concept 'segregation' generally refers to various types of inequalities, especially with respect to differential distribution of social groups to organisational units of a social system (e.g. James & Taeuber, 1985). The concept is mostly associated with the unequal access of geographical entities (neighbourhoods) or social entities (schools, enterprises, occupations etc.). Gender-specific inequalities in the access to industrial branches and occupations have since long been the subject of sociological and economic labour market research, because it was considered as one of the sources of wage differences between women and men (Blackburn, e.o. 1995).

5. Time use is another research topic which traditionally enjoyed much attention from the gender perspective, especially because of the measurement of unpaid female production (household activities etc.). Micro-economic theoretical approaches and analyses are common to the research of labour market processes as well as to studies of unpaid labour. That makes it even more surprising that the analytical approaches of gender segregation have not been applied to gender specific inequalities in time use.

6. The central question in occupational segregation research can be summarised as: why are women disproportionally present in various occupations. The same type of question might be formulated in a gender-oriented segregational approach of time use: **in which degree are some activities disproportionally performed by either women or men and why such might be the case.** The activities are artefactual entities which are defined by a very specific measuring instrument (time use registration). Their true nature is that they are instances of individual behaviour which is the reason why it is adequate to refer to this type of segregation as **behavioural segregation.**

7. There are also some important differences between the entities that figure as objects of analysis of occupational resp. behavioural segregation. They need to be considered before we can make the next step in the analysis of time use.

8. Firstly, there is a difference in the relation between individual persons and those entities. Generally, persons have only one occupation, but they perform many different activities. Will these make a difference? No, but on the condition that we keep our eye fixed on the starting question, especially with regard to the concept 'disproportionally'. An occupation might be qualified as female because in comparison to the general distribution of 'allocated occupational entities' a larger proportion of women is employed in this occupation. In the same way it might be possible to qualify an activity as female when it has been performed by a larger number of women than would be expected from the general marginal distribution. In the next section the exact measurement of segregation will be considered more closely.

9. In the second place occupations are rather long lasting characteristics of persons, while activities are almost transient events. Does it matter? Hardly, because the objective is not to consider individual attributes, but distributions of events: the assumed durability of the distribution is relevant, not the temporariness of the described entities themselves.

10. The third difference seems to be the fact that it is possible to consider not only the participation of people in activities, but also the time they are spending on it, as will be done in this article. But in reality, this is hardly a difference. One might also consider the time spent on an activity as a weight of that activity.

Analogously one might consider the distribution of the time spent on activities as a weighted variant of the participation distribution. In the same way one might conceive weighted variants of occupational distributions, in which the working time is used as the weight. Conclusions from analyses on weighted occupational segregation would generally differ not very much from unweighted segregation, except presumably in the Netherlands and maybe also in Great Britain because of the large proportion of part time work.

12. Apart from the similarities between occupations and activities as possible entities in segregational analysis or between weighted and unweighted variants it remains also very relevant to take in account that each approach does give an answer to slightly different questions. Some questions on the gendered nature of the distributions and the answers on the segregational nature of the inequalities might be considered as more important from an emancipatory view. For example, one might consider the weighting by working time irrelevant compared to the primacy of the equal accessibility of occupations. But a totally different point of view might be taken if part time work appears to be strongly related to career opportunities in those occupations.

3. Measures of segregation

13. Recently Blackburn e.o. (1995) published an useful contribution to the discussion on the measurement of segregation. They describe segregation as ‘the tendency for women and men to be employed in different occupations’ leading to ‘gendered occupations which are disproportionately ‘female’ or ‘male’, so segregation may be defined as the tendency for women to work in female occupations and men

14. Various indices are used in the literature on occupational segregation of which Blackburn e.o. discuss two prominent ones: a) the sex ratio index as applied by Hakim (1981) among others and b) the index of dissimilarity which has been used in many studies on occupational segregation (e.g. Faber, Van Doorne-Huiskes & Van Schuur, 1995).

15. Blackburn e.o. concentrate their discussion on these indices around the basic segregation table (see table 1). Translating the occupations here to activities as being the entities which are examined in this contribution, the segregation table is the result of the grouped aggregation of all activities. After ordering all K activities by the increasing proportion of female participants (being the proportion of women compared to all participants in each of the separate activities) a $2 \times K$ table will result (sex by activities). For the computation of the segregation indices it is necessary to collapse this table into the 2×2 form of the basic segregation table. This last step of collapsing the $2 \times K$ table implies a decision in the course of the analysis: one has to decide where to put the dividing point between male and female occupations. The merit of the article by Blackburn e.o. is that it shows the importance of that decision. In many publications on segregation the authors have not been recognised the implications of this decision sufficiently. The argumentation by which Blackburn e.o. show the statistical problems of the computation of the segregation measures will not be treated here in detail. But the revised computational method they offer as a remedy to the determined defects will be applied. To explain this method their line of reasoning will be summarised here:

- The segregation indices under study (sex ratio index and index of dissimilarity) assume that either female or male activities are defined in relation to overrepresentation of women resp. underrepresentation of women in activities: if the proportion of female participation in an activity should be higher than the female proportion in the sum of participation figures of all activities the activity is called ‘female’. So the dividing point in the $2 \times K$ -table in the composition of the 2×2 -table has been in most segregation analyses the activity for which the proportion of all participants that are female is the same as for the total of all activities.

Table 1 Basic segregation table: men and women in male and female activities

	Activities		
	Male	Female	
Men	n_{11}	n_{12}	$n_{1.}$
Women	n_{21}	n_{22}	$n_{2.}$
	$n_{.1}$	$n_{.2}$	$n_{..}$

Adapted from Blackburn e.o. (1995)

- Closer statistical analysis reveals that the clearest interpretation of the measures of segregation is to consider them as specific statistics of association: the zero level of segregation indicates the missing of any statistical association.
- In their article Blackburn e.o. argue that the segregation measures that were computed from the thus composed segregation table should fulfil the next two conditions which are demanded generally from a satisfactory measure.
 1. The measures should fulfil the criterion of sex composition invariance: changes in the relative proportions of activities by women and those by men (the relation between $n_{1.}$ and $n_{2.}$) should not affect the segregation index.
 2. The same applies to the relative column marginals ($n_{.1}$ and $n_{.2}$) which might be called gendered activities composition: the measure should not be affected by the relative size of gendered activity categories (female and male). This demand will be called: gendered activities invariance.
- Satisfying these specific demands is a necessary condition for the comparability of segregation measures when the marginal distributions of the compository tables are different. If these demands would not be fulfilled, it would be unclear in which degree the magnitude of the segregation measure is either the result of a difference in the marginal distributions of the segregation table or the result of a change in the magnitude of association within the table (which corresponds to the 'real change in segregation'). In almost all studies this problem is occurring. Changes in the participation of women in the labour market in the course of time (and these are manifest in most countries) would produce incomparability of segregation measures. International comparisons of countries with unequal female or male labour participation meet similar problems in the application of segregation measures.
- To consider the changing proportional distribution of women as problematical is not the same as qualifying such changes as irrelevant for the analysis of gender inequality in the labour market, but only to point out that segregation is something very specific. If the proportion of women in the labour market is increasing and if in all occupations it is increasing in the same degree, one should not call that change segregation and the segregation measure should be stable then. The same might be supposed of activities: if all women are performing more activities and the increase is the same for all activities, one should not consider such a development as a change in behavioural segregation.
- Using the segregation table Blackburn e.o. express the two measures of segregation as follows:

$$\text{SR (sex ratio index)} = \frac{n_{22}/n_{2.}-n_{21}/n_{1.}}{n_{11}/n_{1.}-n_{21}/n_{2.}}$$

$$\text{ID (index of dissimilarity)} = \frac{n_{11}/n_{1.}-n_{21}/n_{2.}}{n_{11}/n_{1.}+n_{21}/n_{2.}}$$
- In their evaluation of both measures by applying the two above mentioned invariance criteria. Blackburn e.a. conclude that SR and ID do not meet the demands sufficiently³.
- The remedy of Blackburn e.o. to create segregation measures which make valid comparisons possible is to adapt the construction of the basic segregation table by following a procedure they call 'marginal matching'. After creating the ordered 2xK table, as explained before, one has to choose the dividing point between female en male occupations in such a way that the marginal for female activities ($n_{.2}$) equals the marginal of activities by women ($n_{2.}$). The segregation table has become now a symmetrical

³ Although Blackburn e.o. appear to argue that ID does not meet the criterion of sex composition variance, several other authors (e.g. James & Taeuber, 1985) presented contrary evidence and showed that ID satisfies this invariance demand.

table. On this specifically adapted table the segregation measures (such as the sex ratio index or the index of dissimilarity) can be applied. Thus computed measures can be used for comparisons across time and international comparisons. Wisely enough, Blackburn e.o. add to their argument as a disclaimer that this approach does not provide the ‘true’ measure of segregation.

16. In this paper these measures will not be discussed more extensively. For the discussion on these measures the reader is referred to the articles of Blackburn e.o. and the literature they mention. Apart from the discussion on measures of gender segregation one might also consult the discussion on residential segregation which already started in the 1930’s (see e.g. James & Taeuber, 1985).

4. Information on the data

17. The indices of behavioural segregation are the result of the application of the segregation measures to data on time use. The data have been derived from the Time Use Survey (TUS) in the Netherlands, which were held five-yearly from 1975 up to 1995. The data were collected on behalf of several organisations of which especially the Social and Cultural Planning Office (SCP) should be mentioned. In all five surveys random samples of circa 3000 persons of 12 years and over did register all their activities during seven days in the course of October. They were asked to fill in for each separate quarter of an hour in their diary the main activity, as selected from a precoded list of activities. In all five years the list of activities was kept identical. These surveys have been a rich source for many analyses on time related behaviour (e.g. J. De Hart, 1995).

18. From the Time Use Surveys two types of data on activities have been used, as they were published by the SCP (Van de Broek, Knulst & Niggebrugge, 1997). Firstly, data on the participation of women and men in activities were used. For each of the 178 analysed activities the proportions were computed for women resp. men performing the activity at least once in the observation period of seven days. For the participation data a 2*178 table was constructed. For all activities in this table the row proportions of the female cells in relation to the row marginals were computed and were used to order the rows from high to low. Following the Blackburn-procedure the 2*2-segregation table was produced by choosing the dividing point between female and male activities in such a way that the aggregation of the participation figures of both women and men in the female activities was equal to the sum of all participation figures of women. From this table the sex ratio index and the index of dissimilarity were computed.

19. The second type of data were the mean numbers of minutes that were spent in seven days on each of the activities by women resp. men. For these time use figures exactly the same procedure was followed.

5. Overall behavioural segregation

20. The resulting outcomes of the computation of the measures of behavioural segregation are shown in table 2. From the participation indices one might conclude that in the Netherlands the behavioural gender segregation declined clearly and consistently during the period 1975-1995. It doesn’t hardly make any difference which of both segregation measures one would use. For the indices of overall behavioural segregation which are computed from the time use data the matching procedure is not necessary. The reason for this is easy to understand: the total sum of the mean time spent on all activities equals the total time spent in one week, which is necessarily the same for everyone. The changes in the indices for time use during the two decades are almost the same as the changes in the matched participation indices.

Table 2 Overall behavioural segregation indices

	1975	1980	1985	1990	1995
ID participation matched	0,194	0,186	0,182	0,177	0,161
SR participation matched	0,195	0,186	0,183	0,178	0,162
ID time use	0,187	0,175	0,171	0,164	0,159
SR time use	0,212	0,194	0,191	0,181	0,174

21. Although the segregation indices are very useful indicators for overall trends, they will not show which activities are contributing very strongly to the change in behavioural segregation. In table 4 (See the Annex) the activities are summed up that showed the largest decrease in the differences in participation by women compared to men, and thus contribute the most to the descending segregation. The same has been done for time use. The resulting summary in table 4 shows that the decrease of segregation might for a large part be ascribed to smaller differences between female and male participation in household chores. The impression from the changed differences in time use is almost the same, but a few dissimilarities deserve attention: several activities (e.g. paid work and watching television) appear to be present in the top 20 of the time use summary, that were missing in the participation based list. That discrepancy can be understood as a consequence of the fact that many women and many men did spend time on these activities in both years. The changes have taken place especially with regard to the (differences in the) amount of time spent on these activities.

6. Productive activities

22. If the measures of behavioural segregation would be used for monitoring gender inequalities, careful reflection should be given to the exact question to which this measure would be an answer. If zero segregation would ever be declared to be a policy end in the long term, one would surely not have in mind that gender differences would be unacceptable for all activities. One might suppose that the objections would be directed against an unequal distribution of specific burdensome activities, that are carried out by representatives of one sex but might as well be carried out by the other sex leading to the same outcome. Gender segregation of free time activities might be considered completely acceptable: gender differences between watching television, reading a book or playing computer games are presumably without any objection from an emancipatory view. For this reason it might be preferable to take only those activities in account which could be characterised as above: someone else might do it and produce the same result. Following Hawrylyshyn (1977) those activities are named productive. Without discussing the topic on this place, participation in education is also considered as belonging to the set of productive activities.

23. The measures for productive behavioural segregation can be computed for this smaller set of activities in the same way as was outlined for the complete list of time use activities. On only one point the computation had to be different: because the sum of time spent on productive activities will not be equal to the total time in seven days, it will be required to compute matched measures for time use-based behavioural segregation, too.

24. The values of the segregation indices for productive activities are presented in table 3. The following lessons can be learned from the presented outcomes of the computations.

Table 3 Productive behavioural segregation indices

	1975	1980	1985	1990	1995
ID participation matched	0,297	0,275	0,266	0,245	0,225
SR participation matched	0,300	0,276	0,268	0,249	0,226
ID time use matched	0.459	0.441	0.409	0.381	0.358
SR time use matched	0.464	0.441	0.409	0.383	0.359

- The differences between the two indices: index of dissimilarity (ID) and the sex ratio index (SR) are very small. Except for the measures that are computed for the unmatched segregation table for time use both indices appear to be interchangeable.
- Productive behavioural segregation is clearly higher when the behaviour is weighted by the time spent on activities.
- Time use based productive behavioural segregation is diminishing somewhat faster than participation based productive behavioural segregation.

- Productive behavioural segregation is higher than overall behavioural segregation, as can be seen from comparison with the values presented in table 2. The productive segregation indices show stronger downwards trends than the overall segregation indices. These trends can easily be understood by looking at table 4: the productive activities are represented much stronger among the activities that show large decreases of differences between women and men. And apart from that, the top 5 of activities which show increasing differences, consists almost completely of non-productive activities.

7. Conclusions

25. Occupational segregation refers to the unequal distribution of women and men in occupations. Considering inequalities between the sexes in the participation in daily activities as a behavioural equivalent of occupational segregation has proven to be useful. The widespread measures of segregation appeared to be very well applicable for behavioural gender segregation by using time use data. The analyses of the female and male participation in activities and the time spent on them resulted in perfectly interpretable and interesting outcomes.

26. The main conclusion from the carried out analyses of time use data appeared to be that behavioural gender segregation diminished clearly in the Netherlands in the period 1975-1995. Main causes of these changes are smaller differences in participation in household chores between women and men as well as diminishing discrepancies in the time spent on paid work and school. It would be interesting to explore somewhat further the application of the concept of behavioural segregation on these time use data. It would for example be very attractive to make one step further in the analysis by applying this approach on separate age groups. In that way it will be possible to test the hypothesis that the behavioural gender segregation is changing faster in younger age groups.

8. References

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Table 4. Activities which contribute most to changes in segregation in participation and time use, 1975-1995

top-20 of largest decreases of differences in participation	top 20 of largest decreases of differences in time use
1.F: repairing clothes, polishing shoes	1. F: doing the dishes, preparing the table etc
2.F: doing the dishes, preparing the table etc.	2. M: paid work outside the home
3. F: preparing a meal	3. F: preparing a meal
4.F: vacuum cleaning removing dust, swabbing	4. F: watching television
5. F: cleaning windows and doors	5. F: vacuum cleaning removing dust, swabbing
6. F: making the bed	6. F: embroidery, tinkering
7. F: shopping large grocery store	7. F: making the bed
8. F: laundry	8. M: making homework for school
9. F: taking care of housemate or inmates	9. F: repairing clothes, polishing shoes
10. M: listening to the radio	10. M: paid work inside the home
11. F: taking care of the plants inside	11. F: taking care of the plants inside
12. F: embroidery, tinkering	12. M: listening to the radio
13. F: shopping grocery store	13. F: cleaning windows and doors
14. M: gardening	14. M: playing records, tapes, CD
15. M: waiting during work (non-paid)	15. F: laundry
16. M: paid work outside the home	16. M: sleeping during daytime
17. M: coffee break at work	17. M: travel home-work by public transport
18 F: taking care of other children (not baby)	18. F: resting, taking a nap
19. M: travel home-work by car/motor	19. F: taking care of other children (not baby)
20. F: walking or biking for activities in organisations etc.	20. M: at school, college, university
top 5 of largest increases in differences in participation	top 5 of largest increases in differences in time use
1. F: private use of telephone	1. M: use of computer
2. M: maintenance car	2. F: sleeping during the night
3. M: use of computer	3. F: private use of telephone
4. F: crosswords	4. M: active sporting
5. F: being visited by family or friends	5. F: eating or drinking at home

NB: The activities preceded by F have higher participation figures or time use by women in 1995; the same applies with M for men. The underlined activities are regarded as productive activities