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The Work Arrangements of French Dual-Earner Couples in the 80s and 90s

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Abstract

This paper aims at making an inventory of the different way French dual-earner couples manage their professional schedules. The time-budget approach is criticized for losing crucial information about the socio-temporal substrate of activities: adding up hours dismantles a great part of the social phenomenon studied. A new method is proposed based both on sociological theory and on new methods available to study sequences (Optimal Matching Analysis). This algorithm respects the temporality of activities and is simpler than OMA. This method is applied to the two last French time-use surveys carried on by the French Institute of Statistics (Insee) in 1985-86 and 1998-99. Twelve homogeneous sets of professional organizations are uncovered: nine of them are common to both surveys. Half of the French dual-earner couples have standard and quite synchronized schedules. One couple out of ten has a complementary organization so experiences desynchronization. The socio-professional position of spouses is the main determinant of the groups brought to light, but the explicative pattern is quite complex. Homogamy leads to standard full-time organizations when the social position is high. When the social position of both spouses is low, homogamy becomes irrelevant and the probability of having a non standard organization increases: the schedules of spouses depends on the organization of their respective firms.

Keywords: work, time, dual-earner couples, schedules, optimal matching analysis, sequences comparison.

Résumé

L'objectif de cet article est de recenser les différentes formes d'organisations des emplois du temps professionnels des couples de double actifs occupés. À cet égard, l'approche dite des budgets-temps est critiquée en raison de la perte irrémédiable d'informations sur la date et la chronologie des activités sur laquelle elle débouche : la réduction des emplois du temps à des durées par l'addition des heures consacrées à telle ou telle activité détruit la structure temporelle et par là même une grande partie du phénomène social étudié. Une nouvelle méthode fondée à la fois sur la théorie sociologique et sur la critique des techniques d'Optimal Matching est introduite et appliquée aux données des deux dernières enquêtes Emploi du Temps réalisées par l'Insee en 1985-86 et 1998-99. Douze ensembles homogènes de pratiques sont ainsi mis à jour, dont neuf apparaissent communs aux deux enquêtes. La moitié des couples de double actifs occupés ont des emplois du temps professionnels standards et synchronisés. À peu près un couple sur dix est concerné par une organisation conjugale du travail professionnel de type complémentaire, c'est-à-dire caractérisée par une désynchronisation élevée. La catégorie socio-professionnelle est le principal déterminant du mode d'organisation professionnel. Les conséquences de l'homogamie diffèrent selon le niveau socio-professionnelle des conjoints. Lorsqu'il est élevé, l'homogamie entraîne une organisation standard et synchrone du travail des conjoints. Dans le cas contraire, l'homogamie ne permet plus de déterminer le type d'organisation temporelle observée et la probabilité d'avoir une organisation non standard augmente : les emplois du temps des conjoints dépendent alors de l'organisation de leurs entreprises respectives.

Mots clés : travail, temps, couples de double actifs, emploi du temps, optimal matching analysis, comparaison de séquences.

Introduction

Dual-earner couples represent the new prevailing pattern of work organization within families in France as in most Western countries. It does not mean that women have just started to work but that a profound reorganization of the familial division of work is occurring, helped by the diffusion of wage-earning which has formalized women's labor (Battagliola, 2000). Women's participation to the labor force is now recognized and indeed has become a widespread phenomenon. But with the institutionalization of dual-earner couples comes the constraints of employment contracts especially their temporal requirements. And the arithmetic in question is far more complex than addition or multiplication: a double constraint does not mean that spouses' working time can be added up as if they had become a new entity, *the couple*, who had just decided to work more. The double paid work involvement has to be investigated simultaneously as Nock and Kingston (1984) did, but new tools are required if their project is to be ever completed. The analysis of work cannot be simply extracted from its social and temporal contexts, reducing it to an analysis of mean durations. The analysis of the use of time should not be reduced to the study of correlations between time-budgets. Through the study of the professional arrangements of French dual-earner couples, this paper aims to demonstrate the necessity to reincorporate the analysis of the use of time into its daily ground; its social substrate. Therefore, the significance of the day as the unit of analysis of work is to be established. There, a new approach to study spouses' work arrangements can be introduced, inspired by sociological theory and optimal matching analysis algorithms.

1 Reintegrating spouses work arrangements into their daily substrate

The flow of the day is not a succession of identical moments filled in by activities. This representation, conveyed by an analysis of time use focused on time-budgets, helped and is still helping to detect empirically social changes, like for instance those underlined by Jonathan Gershuny (2000). However, the study of the use of time should not be restrained to time budget, in particular when individual behavior is at stake.

Adding up hours is legitimate when a temporal accounting system is aimed at. An accounting system gives a very synthetic picture of the assets and liabilities of firms but does not explain how these firms managed to reach these particular balanced budgets. This is the same with time-budgets. Trying to get back to the individual decisions which have led to the observed budget is a most perilous task, much more than that performed by a financial analyst whose job is made easy by the availability of additional information such as the firm's biography, whereas for the time-budget analyst, this information is not only missing but would be in fact useless, given the size of the sample required by statistical procedures. Moreover, using time-budget data to grasp individual behavior is quite puzzling knowing that these data come from time-use surveys which provide a wealth of details. It amounts to simplify the data and tries to recover this subsequent loss of detail by using complex statistical methods. It would be simpler and safer not to lose information in the first place. And in that case, the information is the

decomposition of time-budgets into different parts of the day, the scheduling of activities.

1.1 The day as the socio-temporal substrate of activities

As Émile Durkheim noticed (1925), time is a social construction which both reflects the rhythm of the collective life and structures it owing to the stable environment it produces. The cosmic and social context influences what is done, at what time it is done, how, etc. on account of its role on the organization of activities. Indeed, the day is the socio-temporal substrate of life as a mirror of the practical consequences of living in society.

The social regulation of cosmic phenomenons

The cosmic dimension of daily life is embodied in the concepts of day, month and year. The day is determined by the Earth's rotation around itself, the month is approximately linked with the phases of the moon, and the year is connected with the Earth's revolution around the sun. But this correspondence is actually quite loose in comparison with the accuracy of our calendar system (Elias, 1992). It was not so easy to work out a solution to the problem of the varying number of days in a year and this solution, the leap year, is now used with no understanding either of its signification or its origin. But this regularization is not the only social regulation of the cosmic phenomenons.

The precursory works of Pitrim Sorokin (1943) and Eviatar Zerubavel (1985) on the week outlined its peculiar nature. Indeed, the week is not rooted in natural recurrent events like the other calendar elements. The week is a purely social construction to improve the coordination and the synchronization of collective activities (Sorokin, 1943). The number of days has not always been seven. This figure comes from the Babylonian era in which seven was a cursed number so that work was forbidden that day. The length of the week used to vary from 5 to 10 days.

Nevertheless, the exact number of days encompassed by the week is less important than the cognitive operation at the origin of the creation of this calendar division. There is no natural phenomenon between the month and the day to break the continuous flow of days. Hence the necessity of a repetitive short sequence of days to organize the daily life, to enable social coordination. As the international time-zone system splits the continuous rotation of the Earth around itself (Zerubavel, 1982), the week makes the month discrete.

Jiri Zuzanek (1999) recently confirmed the imperious necessity to consider the differences between weekdays and weekends: the daily behavior of employed women and men is very similar on workdays, whereas gender differences reappear on the weekend days: the women's second shift (Hochschild and Machung, 1989) is thus more perceptible on rest days. This catching-up phenomenon occurring on weekends highlights the relevance of the week as the fundamental organizational daily-life unit.

Therefore, the everyday life is structured by the recurrence of two days, the weekend days, during which the majority of people do not engage in supervised professional activities. But the difference between weekdays and weekend days is not limited to work: the week is a cycle completing the other natural cycles; this

system creates a repetitive regularity which enables expectations and transfers of activities according to these expectations. Thus, the week strengthens stability of daily life and as a result helps people organize their daily life.

Consequently, individual schedules observed on a particular day incorporate individuals' expectations about what was to happen that day and the days following. The expectations concerned are not only those of the individuals but also those who interact with them, in particular significant others.

The temporal consequences of family life

Given that the family is the locus of daily life for most people, familial considerations always guide individual behavior. Since children are by and large still an important characteristic of families, their significance in their parents schedule is to be investigated. The role of the spouse on one's schedule is different owing to the spouses relative autonomy and will be presented in the next subsection.

To determine the temporal consequences of children, it is necessary to take into account their specificity. They are not just additional non-working persons. Their place in the family has always been a specific one (Goody, 1988). Children require attention and care, and the growing literature dedicated to these activities clearly indicates how critical this issue is becoming. For instance, Nancy Folbre (1994, 2001) underlines the gap between the paramount importance of children for society (she conceptualizes them as public goods) and the market economy's failure to ensure an adequate quality of child care.

Parents have to take care of their children who depend on other institutional clocks. Therefore, their organizational consequences go beyond the time dedicated to care tasks. They introduce new interactions with institutions like schools, day-care, sports clubs, etc. varying with both their age and sex. Their parents have to integrate these mediated temporal constraints into their own schedule.

In practice, this means that French parents have to take into account that schools usually close around 4 pm and are closed every Wednesday afternoon if not the whole day. Therefore, school introduces differences between opening and closing school hours; in short, that all hours are not equivalents: the temporality of the day is definitely not uniform and children make a handsome contribution to this temporal warping. Other contributions emanate from the societal environment in which families are embedded.

The societal temporality

From a temporal point of view, the societal environment shapes individual schedules. Indeed, institutions, firms, and regulations create a societal temporality which enables social synchronization (Sorokin and Merton, 1937). The opening hours of administrations, shops, restaurants, as well as labor legislation, familial policies, etc., foster a societal temporal space which in turn constitutes the foundations of social interactions. For instance, Eviatar Zerubavel (1982) showed how railroad development in the USA introduced the necessity of a time-zone system in order to improve social coordination.

However, the traditional day/night alternation functioning as the consumption/work metronome is now challenged by the 24-hour economy. Indeed, this phenomenon seems quite developed in the USA since 20 % of men and 12 % of

women who work and live in a couple have non-standard work schedules (Presser, 1987). This phenomenon is much more limited in France on account of the more restrictive labor legislation. Night shifts are socially penalized and were still forbidden to women only a year ago. From this point of view, work schedules are on the whole likely to be different according to the position of the couple in the social space.

The social temporality

Indeed, the probability of working at each moment of the day depends on the position of the individuals within the social space; that is to say, the amount of cultural and economical capital they own. To a certain extent, the industry is likely to introduce some distortion into this system. But the occupation is likely to be the main determinant of the possible sets of schedules. For instance, in a railroad company, a conductor is likely to have night shifts contrary to a secretary employed in the same company. Pierre Bourdieu (1979) underlines the temporal dimension of the social stratification:

> It would be necessary to analyse how the working conditions and, more precisely, the *disciplines*–especially temporal–, imposed by firms, tend by themselves, and apart from any ideological inculcation, to strengthen continuously the dispositions inculcated by a prime education which reproduce both by necessity and will, the necessity, the harshness and the rigidity of the existence it prepares for. (p. 535)

The temporal discipline at issue here deals with the rhythm of work, that is to say the rhythm at work as well as the rhythm work transmits to daily life.

The individuals' position in the social space are likely to distort the chance of the different work schedules to happen hence the kind of daily life they are to experience. Therefore, individuals' daily schedules do not only give an account of individual lives but also of their lives as members of a particular family and society with a particular set of cultural and economical capitals.

Consequently, the analysis of spouses' work arrangements must take into account their socio-temporal dimension. Two individuals can work the same amount of time, but one can work night shifts and the other daily fixed schedules. If these situations are mixed up then it is no wonder that it is so difficult to get good R^2 from regression analysis. Adding-up hours as if they were potatoes dismantles the phenomenon studied: it amounts to neutralize all these differences to obtain a mean result that in fact means nothing since, as Maurice Halbwachs (1923, p 301) says, "if we eliminate or neutralize all the differences, indeed, we can wonder what is left, if in fact we do not first eliminate the matter we are studying". This is not to say that the analysis of daily schedules is vain but that new methods are required to extract all the relevant information contained in the time-use diary. But this is not the only issue at stake in studying the professional arrangements of dual-earner couples given that the phenomenon studied is two-dimensional.

1.2 Synchronicity of spouses' professional schedules

The study of dual earner professional arrangements requires the simultaneous analysis of two work schedules. This task is quite easy when only the mean

duration of work is taken into account. But the practical meaning of *action* is to be considered if behavior is to be grasped. Therefore, dual-earner professional engagements is to be reintegrated into its daily substrate if we really want to comprehend how couples combine their professional schedules to deal with their daily constraints and wishes. The part-time job is a solution, primarily affecting women in France (31.6 % of the working women and 5.7 % of the working men in 1998). This kind of work is not always a first choice but half of the women who hold a part-time job declared they were searching for a better balance between their professional and family lives (Bourreau-Dubois et al., 2001).

Part-time jobs are not the only way to combine a double professional engagement with a family life, especially childcare. If individual activities are reintegrated into daily life then subtle arrangements based on shifts between spouses' professional schedules appear. For instance, one spouse can work early in the morning and is thus available for her children in the afternoon while the other spouse is working evening shifts and take care of the children in the morning. When work is reduced to mean durations, the synchronization of spouses work schedules is invisible though it is a fundamental component of the understanding of observed behavior. The essence of the study of dual earner couples lies in the synchronization of their professional schedules. Yet, the study of the synchronization of work schedules is a quite recent issue tackled by only a few sociologists up to now (Nock and Kingston, 1984; Kingston and Nock, 1985; Kingston and Nock, 1987; Nock and Kingston, 1988; Presser, 1987; Presser, 1994; Chenu and Robinson, 2002). But again, conjugal synchronicity is too often reduced to a single number measuring off-scheduling, that is to say when spouses' work schedules do not perfectly match one another. There is some off-scheduling when one spouse works more than the other (in this case, off-scheduling is structural) or when the spouses merely have diverging work schedules (one works night-shifts and the other day-shifts). The measurement of synchronization by a single index mixes up incomparable numbers extracted from their socio-temporal substrate. Alain Chenu and John P. Robinson tried to decompose their index into a gross and a net index using a measure of structural dissimilarity between work schedules. But this structural dissimilarity index only measures the duration of incompressible off-scheduling given that the rest of the spouses work schedules were perfectly synchronized. From the moment that this condition is not fulfilled, this measure becomes useless because it arbitrarily reduces the desynchronization observed for couples who are not perfectly synchronized anyway. For instance, for a couple where the husband worked a night shift of nine hours and the woman worked in a office during the day for seven hours the real structural desynchronization was nil but the Chenu and Robinson's structural desynchronization index added up to two hours, the difference between the spouses work durations. Consequently, the off-scheduling issue needs to be replaced in the day and in relation to spouses work engagement if it is to be understood.

Off-scheduling appears to be a major implication of a double professional engagement and as a result is to be considered in this analysis. Hence, what we need to know is, for each time slot, what combination of professional activity is observed among four possibilities:

1. No spouse is working;
2. Only the husband is working;
3. Only the wife is working;

4. Both spouses are working.

This amounts to represent the spouses' professional organization as a one-dimensional temporal process evolving in a four-state discrete space. This synthetic representation of a couple workday is focused on synchronization but does not imply by itself that its embodiment into a socio-temporal substrate is taken into account. This is the task assigned to the method used to analyze these conjugal temporal processes.

2 A new method to compare schedules

What we need is a method to respect both the order of the events and the particularity of every point in time they appear. In addition, we know that every moment of daily life is liable to incorporate expectations about the future: the present not only depends on the past but also on the future. This is a crucial point because this is a direct violation of a fundamental hypothesis of the event-history models. Thus, the classical statistical methods to analyse stochastic processes cannot be used.

Andrew Abbott imported into sociology a new class of methods from biology called Optimal Matching Analysis (Abbott and Forrest, 1986; Abbott and Hrycak, 1990; Abbott, 1995; Abbott and Tsay, 2000). This method can be used to compare sequences as a whole and, since there is no statistical hypotheses behind them, seems particularly interesting for the analysis of the professional organization of dual-earner couples. Actually, Optimal Matching algorithms are just a way to transform sequences into distances between individuals. This method is further introduced and improved[1] upon to suit the theoretical requirements of this study.

2.1 The Optimal Analysis technique

Optimal Matching Analysis comes from molecular biology and was aimed at the decryption of DNA (Sankoff and Kruskal, 1983). This technique was introduced into sociology by Andrew Abbott (1986). This method is basically an algorithm which produces a distance matrix out of a set of sequences. Therefore, OMA is just a particular way to work out dissimilarities between individuals. This means that other procedures, like clustering or multidimensional scaling, are required to complement the analysis, but above all that this method should be used carefully and not like a black box.

A short introduction to OMA

OMA is hence a way to measure the degree of dissimilarity between two sequences, i.e. two sets of ordered events. In OMA, the dissimilarity is the cost required to make identical the two sequences with the help of three basic operations: insertion, deletion (indel operations) and substitution. Each operation is associated with a cost and the dissimilarity produced by OMA is the minimum total cost required to

[1]This is not exactly an improvement since a new algorithm is introduced; however, it is based on the OMA philosophy.

match the two sequences[2]. Consequently, choosing the cost parameters represents the crucial point of this technique.

For example, let us condider two sequences, X and Y, of a space with only two states, A and B (see table 1).

X :	A	A	A	A	B
Y :	A	B	B	B	

Table 1: Two simple sequences.

These sequences may have different lengths, even though in the case of the spouses' professional schedules, all the sequences have the same length. To transform the sequence X into the sequence Y, it is possible to suppress the first three As and to add two Bs, operations represented by the empty set operator ($\emptyset$). When an empty set is on the first line then it means that the element on the second line is inserted and when an empty set is on the second line, it means that the element in the first line is suppressed (see table 2).

X :	A	A	A	A	B	$\emptyset$	$\emptyset$
Y :	$\emptyset$	$\emptyset$	$\emptyset$	A	B	B	B

Table 2: Transformation of the sequence X into Y with the help of three deletions and two insertions.

Obviously, this is not the only solution to match the two sequences. This can be done with three substitutions and one deletion (see table 3).

X :	A	B	B	B	B
Y :	A	B	B	B	$\emptyset$

Table 3: Transformation of the sequence Y into X with three substitutions and one insertion.

If a cost is associated with each operation then it is possible to determine the cost of each matching as the sum of the weighted costs. Eventually, the dissimilarity is the minimum cost to achieve sequence matching.

Traditionally, each indel operation costs one unit. The choice of the substitution cost depends on the interpretation of replacing a state by another one. If the transitions do not have a meaning, the substitution cost is usually set to two units (Abbott and Tsay, 2000). A data-based substitution cost system can also be derived from the frequencies of the transitions between all states, that is to say from the markov matrix, which are used as measures of proximity between these states: thus, substitutions between two close states would cost less than between two states which are far away in terms of frequencies. This solution amounts to the same thing as using diachronic closeness between states to build a synchronic proximity matrix between states and to use it to assess the diachronic proximity of individuals (Abbott and Hrycak, 1990). The conclusion is that the costs system is to be carefully chosen and adapted to the issue analysed.

[2]This distance is actually the Levenshtein distance (Sankoff and Kruskal, 1983).

The ineffectiveness of OMA to analyze spouses' professional organization

To choose the best cost system, we must keep in mind that the dates of the events are of paramount importance in our study. The cost system must be able to discriminate between two sequences which are quite similar from the point of view of the ordering of states but moved forward or put back one hour, because this kind of shift is crucial in this analysis. The indel operations tend to separate events from their date of occurrence since each indel operation has all the earmarks of inserting or suppressing time, thereby destroying all the temporal structure. Consequently, these operations should be rarely used. But if the substitution costs are too high then this kind of operation is never to be used, that is why Abbott (1990) suggests to choose an indel cost at least equal to the highest substitution cost increased by the difference between the two highest substitution costs. This is an indirect way to penalize the use of the insertion-deletion operations. For example, let's consider two sequences of identical length, X and Y, of a three-state space whose main differences lie in their temporal shift (see table 4).

X :	A	A	A	A	B	B	B	B
Y :	C	C	A	A	A	A	B	B

Table 4: Two shifted sequences.

With a traditional cost system, the optimal matching (two insertions of C and two deletions of B) is associated with a cost of four units. If only substitution operations are used then the total cost is $2 \times 4 = 8$. Therefore indel which are costs too small in comparison with substitution costs leads to the vanishing of the temporal shifts between sequences.

Consequently, Andrew Abbott's recommendation is to minimize the use of indel operations in favor of substitutions. As a matter of fact, when the main goal is not to detect patterns of consecutive events then the indel operations are useless. But if only substitution operations are used[3] then there is no more an optimal matching method but simply a matching procedure or a sequence comparison.

2.2 An algorithm to compare the conjugal professional organizations

Therefore, the comparison of the professional arrangements of the French dual-earner couples requires a new algorithm to work out distances from sequences. The algorithm proposed here is inspired both by OMA and theory. Sociological theory tells us that calendar and other time concepts both reveal the rhythm of collective activity and ensure its regularity (Durkheim, 1925, p. 54): it means that the different moments of the day are different because of the social activity, because what people do varies with time owing to their expectations on what other people do. If daily activities are shaped by the collective rhythm then we

[3]It is actually equivalent to use systematically the upper bound of the Levenshtein distance which correspond to the case where the best transformation is only composed of substitution operations with sequences of identical length (increased by as many insertions when one sequence is longer).

need to uncover it. However, the collective rhythm is multidimensional as outlined in the previous section: the social rhythm is like an ocean with different streams. Uncovering the collective rhythm means revealing all those streams. Since we are only interested in the professional arrangements of dual-earner couples, the whole ocean will not be taken into account but only the streams related to work, that is the streams related to the four different state possible we defined. Once for a certain point in time the relative strength of the different streams is gauged, then it becomes possible to determine whether two couples are drifting together or apart.

Consequently, we need a distance built on social activity, relative to what the entire sample do. Additional information are thus required to understand individual behavior; these additional information are here what people do at every time, in statistical words we need to derive substitution costs from the observed transitions between states. But the usual solution, which relies on a single transition matrix, is not enough since these general transitions hide temporal variations which are the substance of time. Consequently, as many transition matrices as time slots[4] will be used to compute the proximity between states at every point in time.

This solution is not only appealing from a theoretical point of view; it also gives an endogeneous answer to the problem of the distance between activities at certain points in time. Indeed, even if we know that night-shifts are quite uncommon in France it is rather impossible to determine the distance between working or not for each moment of the night, and it is definitely impossible to determine theoretically distance matrices when it is the couple and not an individual work schedule which is at stake. Thus substitution costs vary with the time and the degree of scarcity of the transition between the states for the particular time considered. The substitution cost between the states i and j at time t, $d_t(i,j)$, is thus defined as:

- If $t \notin \{1, T\}$, then

$$d_t(i,j) = \begin{cases} 4 - p_{t,t+1}(i,j) - p_{t,t+1}(j,i) - p_{t-1,t}(i,j) - p_{t-1,t}(j,i) & \text{if } i \neq j \\ 0 & \text{otherwise} \end{cases}$$

- If $t = 1$, then

$$d_1(i,j) = \begin{cases} 4 - 2p_{1,2}(i,j) - 2p_{1,2}(j,i) & \text{if } i \neq j \\ 0 & \text{otherwise} \end{cases}$$

- If $t = T$, then

$$d_T(i,j) = \begin{cases} 4 - 2p_{T-1,T}(i,j) - 2p_{T-1,T}(j,i) & \text{if } i \neq j \\ 0 & \text{otherwise} \end{cases}$$

with $p_{t,t+1}(i,j)$ as the empirical probability[5] to reach the state j at time $t+1$ given that the previous state was i.

Therefore, the rarer the transition shifts between two states (the weaker the stream) in a single time slot, both before and after, the higher the distance

[4] If there are n time slots then only $n-1$ transitions matrices between two adjacent dates exist.
[5] The empirical probabilities $p_{t,t+1}(i,j)$ and $p_{t,t+1}(j,i)$ are hence not equal in theory.

between these states at that time. For instance, since the transition between the states "no spouse work" and "only the husband work" at one AM is uncommon, the distance between a couple with a night shift and a couple with a day shift will be high. But since such a transition is quite common around nine AM, couples with standard work schedules will be quite close. To put it in a nutshell, if we want to estimate the proximity between two individuals at a certain time, we look at the proportion of the sample which has transited between the two states considered between[6] $t-1$ and t and between t and $t+1$: if this proportion is high then it means that a lot of people "hesitate" between the two states thus that those states are close. As a consequence, the distance at every moment between two individuals depends on what the entire sample has done at the last stage and is about to do in the next one, which is a way to have both a dynamic and a relative definition of which behavior is common and uncommon.

Although the sequence comparison algorithm proposed here is inspired by Optimal Matching techniques, it avoids some of its pitfalls by removing the indel cost issue, and, since it is no longer an optimization procedure, the result is not anymore the product of hidden trade-offs.

3 The French dual-earner couples professional arrangements

3.1 The 1985-86 and 1998-99 French time-use surveys

France has a quite long tradition of investigation of the use of time after its participation to the seminal international study by Alexander Szalai (1972). The last two French time use surveys carried out in 1985-86 and 1998-99 by the French institute of statistics (Insee) are used to investigate the dual earner couples work schedules.

The number of persons who responded to all the questions is 16,155 in 1985-86 and 15,441 in 1998-99. Both surveys use leave-behind diaries but with different time slots. The 1985-86 survey has 5 minutes slots while the 1998-99 investigation records activities each 10 minutes. People living in collective accommodations such as rest houses, hospitals, barracks, etc., are excluded from the sample since only personal housing is sampled. People on vacations are equally not interviewed. Since this study is about dual-earner couples, these biases are not serious.

Given the scarcity of homosexual couples[7], only heterosexual dual-earner couples who worked[8] the day they filled in the diary will be considered.

The difference of the sample sizes (see table 5) is due to the sampling procedure. Once a sample of accommodations is constituted, some of their occupants are interviewed. In 1985, one occupants among those older than 18 was selected in random order using the Kish method and interviewed; if this person was living

[6]Rather than choosing the $(t-1,t)$ transition matrix more than the $(t,t+1)$, it seemed more interesting to use both in order to lightly smooth the trends.

[7]None homosexual couple is to be found in the 1985-86 survey and approximately 20 in 1998-99.

[8]The definition of work used here encompasses having a meal with colleagues at work or work-related travels. The aim is not to measure accurately working time but the amount of time dedicated to work in general: when you have a meal with colleagues, you are not available to do something else.

Subsample	1985-86	1998-99
Childless dual-earner couples	425	330
Dual-earner parents	1,038	781
Total	1,463	1,111

Table 5: Subsamples size.

maritally, her spouse was also interviewed. In 1998, every occupant older than 15 was systematically interviewed.

But the differences between the two surveys exceed the sample sizes since the time slot of the diary has doubled in 1998 to reach 10 minutes. The consequences of this methodological difference is quite hard to grasp but is likely to sway only small durations activities. Given that work is very unlikely to be classified in that category, this methodological difference seems harmless for this study.

3.2 Dual-earner couples professional arrangements and their determinants

The sequence comparison algorithm proposed in the previous section is applied to the 1985 and 1998 French surveys. Since the distances between couples depend on what the entire sample do at every moment, is it legitimate to apply this algorithm to the two pooled surveys? Given that distances are directly related to the transition matrices, it is equivalent to ask if we can add the weighted transition matrices time slot by time slot and compare professional schedules of couples as if they were coming from the same sample. If we omit the differences in the sampling techniques used, it seems acceptable to pool the samples if the transition matrices are roughly equivalent time slot by time slot. But if this is not the case, then pooling samples will distort the distances which are based on the degree of scarcity of transitions: distances will artificially increase for one sample and decrease for the other. For instance, if night shifts or non standard schedules are differently represented in the two samples then it will affect systematically the distances. To put it in a nutshell, such a comparison is legitimate only if the structure of the transitions between states are roughly the same at every point in time for both samples.

The graphical comparison of the difference of the distance between states at every point in time indicates that significant changes have occurred between 1985 and 1998, especially between midnight and 6 PM. If the set of distances between two particular states is viewed as a time series, then we can use a white noise test to statistically ground this visual structure difference[9]. None of the six time series satisfies the white noise properties. Consequently, the analysis will be performed separately on the two samples.

The distance between couples produced by the sequence comparison algorithm[10] is then use as input for a clustering algorithm. The algorithm used is

[9] A white noise is a time series which is null on average, whose standard deviation is constant (independent of the time), and which is not correlated with its past. In brief, it is a pure random process, a residual. The white noise test used here is the Bartlett's Kolmogorov-Smirnov statistic (Bartlett, 1966).

[10] The algorithm has been implemented in the SAS software as a macro using the IML module. The code is

the flexible-beta method proposed by Lance and Williams (1967) and reviewed by Milligan (1989). This clustering algorithm is indeed very flexible owing to a parameter used to smooth distances but is also able to produce clusters of unequal size contrary to the Ward method.

Joel H. Levine (2000) recently criticized OMA applications in the social science field for the lack of evaluation of their validity. Levine is right, but the lack of evaluation seems a rather more general issue in the social sciences where statistical methods are too often used as black boxes. The difficulty to assess the quality of OMA-like methods stems from the nature of the output obtained: after all, OM methods are just a rule to compute distances between individual in terms of a particular set of variables. Since another method is required to access and assess the output, the question has no answer. But the quality of the clusters will be here investigate, mainly with the help of graphical tools. First, the clusters are characterized using the underlying variables of the analysis: measures of desynchronization and work durations. These information are completed by qualitative insight on the distribution of spouses work on the day based on visual representations of the clusters.

The professional arrangements of dual-earner couples

There are ten groups of professional arrangements in 1985 and eleven in 1998. Nine are common to the two surveys if we compare them visually[11]. To a great extent, the professional arrangements appear to be stable in their diversity[12]. This underlines the quality of the data and the accuracy of the algorithm used. The clusters are now described using both their underlying variables (see figures 1 p. 20 and 3 p. 22 for 1985 and figures 2 p. 21 and 4 p. 23 for 1998) and their visual representation (see figures 5 p. 24 and 6 p. 25).

The box-plots of the various underlying variables of the family work day for each cluster allow a visual assessment of the quality of the forms of dual-earner couples professional organization uncovered. The variables used here are: absolute desynchronization, relative desynchronization[13], absolute desynchronization due to the husband, absolute desynchronization due to the wife, spouses' individual and total work time, and husbands' share of the total familial work time. The most striking result lies in the thickness of the boxes and the clear-cut median values, indicating a low intra-class variance and an excellent discrimination, in short that the clusters found are homogeneous and distinct.

Group 1: perfectly synchronized full-time workers These couples are characterized by a synchronized and standard professional schedule: they start to work between 7 and 9 AM, they eat between noon and 2 PM[14], and they

available on request, see the address of the author.

[11]The best visual representation of the clusters is a graphic representing for each time slot the percentage of couples belonging to the four different states. See figures 5 p. 24 and 6 p. 25.

[12]This does not mean that the characteristics of the couples belonging to the clusters are identical for both surveys.

[13]The relative desynchronization index measures the The length of the family work day measures the amount of time

[14]Some people eat at their workplace, other at home. Actually there were originally two different clusters only because of the place of lunch (the algorithm is definitely very accurate). Since this difference is minor and for the

stop working between 5 and 7 PM. The desynchronization of these couples is very low both in absolute and in relative terms. These couple are synchronized[15] and very symmetrical in terms of work time. Their professional involvement is strictly equal to the legal work time in France at that time (median of 8 hours a day). There is no difference in the shape of this category between the two surveys: they both represent approximately one third of each samples and are by far the most widespread conjugal professional organization.

Group 2: well synchronized asymmetrical full-time workers This professional organization is quite similar to the previous one except that in this group, husbands work later in the evening than their spouse. Therefore, their work time is higher (the median is slightly superior to nine hours) and if they are less synchronized than the first group, this synchronization is purely structural even if it still reflects a lesser masculine availability. This type of professional organization is the second most widespread work arrangement with 20 % of the sample in 1985. This category is slightly different in 1998 since there are fewer households (15 %) and because of the accenting of its main feature: husbands tend to stop working later in 1998 (median work time superior to 10 hours) hence increasing the absolute desynchronization.

Group 3: quite synchronized asymmetrical full-time workers This group is another variant of the predominating professional organization. Spouses' schedules are less synchronized owing to the divergence of their starting and ending time: starting time ranges from 5 to 10 AM and ending time from 7 PM to midnight. Husbands are working slightly more than their spouse in both samples but they work more than the first two categories only in 1985. This kind of professional organization tends to grow since it represents 12 % in 1998 compared with 7 % in 1985.

Group 4: full-time husbands with morning part-time wives The desynchronization observed in those couples is chiefly structural since it stems from women's fewer work hours (the median is slightly inferior to 6 hours). Their husbands have a schedule and a work time very similar to those of the first group. This type of organization seems stable (around 8 % in both samples) but women tend to start to work earlier in 1998 than in 1985.

Group 5: full-time husbands with afternoon part-time wives This professional organization is almost perfectly symmetrical with the previous group. The biggest difference stems from women schedules' shift to the right: they tend to work not only the afternoon but also the evening. Consequently, the synchronization is lower than for the group 4.

Group 6: complementary couples Husbands work early in the morning whereas their spouses work a little full time. Most women have a standard office schedule but some of them start to work quite early in the morning hence stop working earlier in the afternoon. This type of professional organization is stable

sake of the presentation, those clusters have been merged.

[15]The only source of desynchronization is a slight shift of the starting and ending of work.

(around 7 % in 1985 and 1998) but the complementarity is more emphasized in 1998 owing to women's more standard schedules.

Group 7: full time wives with late husbands The main characteristic of these couples is the shift to the right of men's professional schedules. They are working full time in 1985 but not in 1998. Their wives are working full-time and have a standard schedule, which is slightly shifted to the right in 1985. They are working more than their husbands in 1998. The desynchronization rate is subsequently rather high both in 1985 and 1998.

Group 8: short time wives with full-time husbands The median women work time is around two hours and a half. Men's schedules are very close to those observed in the first group. The desynchronization is subsequently large but only reflects the difference between spouses' work time. The morphology of this group is quite similar in 1985 and 1998 but this group is less numerous in 1998.

Group 9: completely desynchronized and complementary couples These couples are perfectly desynchronized: men are working night shifts whereas their spouses are working during the day. Both spouses are full-time worker and their absolute and relative desynchronisation is maximum.

Group 10: symmetrical morning part-time couples (only in 1998) Both spouses work part-time, mainly in the morning. Their desynchronization is low in absolute but quite high in comparison with their work time.

Group 11: symmetrical afternoon part time desynchronized workers (only in 1998) Theses couples worked a few hours but at different moment of the day. Their desynchronization, though low in absolute, is very high in view of their work time.

Group 12: asymmetrical part-time couples (only in 1985) Wives have worked more than their husbands, but both of them have a low work time. The work range is either in the morning or in the afternoon. But this group is not equivalent to the two previous categories owing to the night work observed in the group 11. The absolute desynchronization is low in absolute terms but very high with respect to spouses work time.

This interpretation is also confirmed if the medians of all the underlying variables of the clusters are represented (see figures 7 p. 26 and 8 p. 27).

The morphology of each of the 12 main professional arrangements is quite clear. Around half of the couples belong to the first three groups, characterized by various degrees of desynchronization of full-time standard professional schedules. The combination of a masculine full-time professional commitment with a feminine part-time job remains popular (groups 4 and 5; 14 % in 1985 and 1998). The couples belonging to the group 7 have an opposite organization: the wife is working a full standard schedule whereas their husbands are working in the afternoon, full or part-time. One couple out of ten adopts a complementary

professional organization resulting in a high degree of non-structural desynchronization (groups 6 and 9). Since both spouses' work time had to be positive to be considered as a dual-earner couple, the other groups (8, 10, 11, and 12) gathers couples with a rather low conjugal work time and are possibly weekend days.

There are no dramatic changes between 1985 and 1998. There are more households in the group 3 and less in the group 2 in 1998 than in 1985; the features of these groups are more accented in 1998 (men are working more): it suggests that the desynchronization of the double full-time couples might have slightly increased. But this could mean that these groups are differently constituted.

This study of the different forms of professional arrangement of the French dual-earner couples brings to the fore the absolute necessity to reintegrate this kind of analysis in its temporal frame of reference. For instance, the group 5 has a percentage of desynchronization superior to the group 6, yet the nature of the desynchronization is totally different: it is the result of women part-time job in the first case and the consequence of real desynchronization due to a complementary organization of work in the second. But in any event, the crucial point remains that time is not the constant flux symbolized by the chronograph: the tool should not be confused with the process whose true nature is social (Elias, 1992).

Sources of the professional arrangements

Although the professional organization of couples has been simplified using a one-dimensional time process, information from both spouses is needed to uncover the characteristics of the different groups of arrangements. The explicative variables used here are: a modified social class indicator[16], occupation industry, educational attainment, age, freedom to choose the professional schedule, number of children, presence of preschool children, composition of the children, weekend days, and geographical location mainly.

Owing to the great number of variables, only a few methods are available. Contingency tables are the best tool to analyze the clusters: using shoe leather (Freedman, 1991) is the only way to get an insight into this kind of situation[17]. Nonetheless, classification tree[18] will be used in order to check the findings. The main result is the prominence of the social class to explain the various groups previously described: social homogamy explains largely the arrangements observed.

Group 1: middle-class couples In 1985, men belong disproportionately to the intermediate employees, office employees and skilled worker groups. Women work as office employees or in factories as skilled or unskilled workers. More precisely, male employees go together with female employees and male worker with female worker. These couple are clearly homogamous and belong to the middle class; they did not have the possibility to choose their schedule. The situation

[16]This indicator is based on the French *Professions et Catégories Socioprofessionnelles*. Thirteen classes are distinguished: farmers, craftsmen and shopkeepers, professionals, executives and engineers, professors, school teachers, intermediate employees (mainly in the educational and health industries), office employees, skilled worker, unskilled worker, unskilled service worker, drivers, policemen (only for men), and saleswomen.

[17]Contingency tables have not been reproduced because of the size it would have required but are available on request.

[18]See Breiman et al. (1984) for a presentation of this technique.

is different in 1998: there are more couples of executives hence relatively less blue-collar workers. However, the homogamous dimension is still overwhelming.

Group 2: upper-class or middle-class constrained couples The couples of this group are, in 1985, characterized by homogamy, but the position in the social space is higher than previously. There are mainly couples of professionals, of executives, of shopkeepers and craftswomen, of professors, of school teachers and of intermediate employees. There are also couples of white- and blue-collar workers and some saleswomen. In 1998, the latter couples have almost disappeared of this class. Subsequently, most men have flexible working hours, but homogamy is lower: most of male executives' spouse is not an executive but an employee or a teacher; most spouses of craftsmen are employees or intermediate employees.

Group 3: self-employed couples The self-employed category encompasses the couples of craftsmen and shopkeepers which predominate this type of professional organization in 1985. In this kind of occupation, couples usually work together and the desynchronization observed is hence particular and probably aimed at covering the maximum range of opening hours, spouses taking over one another. But this is less the case in 1998: couples of farmer and of skilled workers and employees have joined the craftsmen and shopkeepers couples. There are also heterogamous couples where the husband is an executive and the wife belong to one of the social position ranging from middle to upper-class, and other couples where the wife is employed in the trade sector.

Group 4: female employees The main characteristic of these households in 1998 is that wives work as office employees and to a lesser extent as service employees and live either with an intermediate employee or a skilled worker. These families do not differ in their composition from the other groups but part-time is largely chosen. This is also true in 1998 although there are more unskilled worker females.

Group 5: female employees Two possibilities for these couples in 1985: either they are couples of shopkeepers and craftsmen and craftswomen or couples of skilled workers with female service employees or office employees. In 1998, women are also service employees as well as school teachers (most of them worked on a Wednesday or a weekend day).

Group 6: imposed schedulings These couples did not have the choice of their schedule. Their characteristics are close from those of the first group in 1985: they are mainly couples of white collar workers and of skilled worker; sales clerks women and drivers are also numerous. It seems that the complementary professional organization is not desired but is the result of the combined constraints of different schedules. These differences happen when the couple is either heterogamous or homogamous but in an industry and at level where non standard schedules are probables.

Group 7: heterogamous couples In 1985, group 7 gathers both homogamous and heterogamous couples. The homogamous ones belong mainly to the craftsmen or shopkeepers occupation; we can suppose that these couple gather the baker (who bake during night) and his wife (who sell the bread during the day): in brief, this kind of homogamy is hiding a familial division of the work hence is not a true professional homogamy where both spouses perform the same set of tasks. The other couples are composed of middle and lower class heterogamous couples with a lot of factory skilled workers. The situation is more intricated in 1998 in terms of the distribution of men and women social class but this lack of particularity goes along with a high level of heterogamy.

Group 8: true and false short time female workers Female service employees, office employees, craftsmen and shopkeepers: these three occupations, with a few nurses, are over represented in this group in 1985. Except for the employee group, the nature of these occupations allows them to organize their schedule with some freedom and explain the organization observed. Consequentially, there are two kind of short time: real (service and office employees) and false short time. Indeed, the difference between professional work and domestic work is slight in the farmers (who appear in 1998) and shopkeepers occupations.

Group 9: factory workers This professional organization is quite easy to describe. Most of those men are factory workers who did not choose to work a night shift. A few policemen are present in 1985 as well as some (male) nurses and foremen in 1998.

Group 10: flexible schedules on week days These couples have in the whole quite flexible schedules: couples of professors and of school teachers who worked on a week day, couples of school teachers who worked on a week day, farmers couples who worked mainly on week days but not only. But there are also couples where the man is a driver. The first category of couples are homogamous contrary to the other.

Group 11: flexible schedules These couples mainly have quite flexible schedules: couples of professors and of school teachers who worked on a weekend day, couples of school teachers who worked on a week end day, shopkeepers couples who worked mainly on week days but not only. There are also couples where the wife is a service employee. The first category of couples are homogamous contrary to the other couples.

Group 12: flexible and non standard schedules These couples mainly have quite flexible schedules: couples of professors who worked on a week day, couples of school teachers who worked on a Wednesday or week end day, farmers couples who worked mainly on week days but not only. But there are also couples where the man is a driver and other couples where the woman is a service employee. The first category of couples are homogamous contrary to the other couples.

These results are evidenced by classification trees (see figure 9 p. 28 for 1985[19]): the two most discriminating variables are the *Catégorie socioprofessionnelle* of the spouses (PCS1 and PCS2 in the figure). These variables reappear farther in the tree, underlying the complexity of the interactions between those dimensions. However, the picture drew by the classification tree is unambivalent:

1. The left part of the tree shows us the consequences of a high social position: except for the craftsmen and shopkeepers, it leads to a synchronized and standard conjugal schedule (categories 1 and 2). But the counterpart of this regularity is the possibility of working on weekends.
2. The right part of the tree is more entangled as a result of the higher variety of the occupations of these couples. But on the whole, the middle-class is likely to belong to the first group or the women to work part-time.

Nevertheless, this analysis is far from perfection: around 50 % of couples are misclassified. This is not really a surprised since this kind of analysis is not a substitute to thought: the analyst must import his knowledge into the analysis to make the most of it. Here, information about the temporal requirements of the social class and homogamy is needed.

Conclusion and discussion

This article introduced a new method to investigate the use of time. The algorithm is inspired both by sociologists who evidenced the social nature of time and by the development of alternative methodologies to analyze sequences. This algorithm is both simpler and better than Optimal Matching Analysis to study daily activities. The method proposed here to analyze the professional organization of dual-earner couples seems reliable: most groups are common to both samples and their quality, assessed by visual analysis of variance or representation of the clusters, seems rather good. However, this method should be applied to other samples in order to ascertain its quality.

Socio-professional homogamy is linked to conjugal organization of work. But this relation is not simple. When workers have some autonomy, which goes along with a rather high social position, couples are quite synchronized (group 2) because they both work standard schedules. However, the synchronization is not maximum owing to the temporally extensive professional involvement, sometimes asymmetrical. Since middle-class occupations lead less systematically to standard schedules, homogamous middle-class spouses can belong either to the same category than higher social position couples or to its more synchronized and less extensive version (group 1). In both case they have less the ability to choose their schedules and, somehow, endure them. When we go down the social ladder, the non structural desynchronization is likely to increase (categories 6, 7 and 9). Indeed, when the social status of both spouses is low, then it does not matter whether they are homogamous or not: the probability of a non standard conjugal professional organization is higher. But desynchronization might be desired as a mean to manage the constraints of a familial life: this kind of organization allows spouses to take turns with children. However, familial characteristics (number and sex of children) does not seem to have an impact on

[19]In this preliminary version of this paper, only the 1985 results are presented.

the forms of professional organization observed. The case of the self-employed (farmers, shopkeepers and craftsmen) is different since their occupation is still largely connected to the family as a unit of production. In such couples, the division of work is concrete: this is not the work as an abstract concept, used to describe the way spouses share responsibilities, but the concrete work required to daily run the familial business. The flexibility is high and leads to various degree of desynchronization.

If the socio-professional relative (homogamy) and absolute positions in the social space are linked to the kind of familial organization of work observed, this relationship is complex because many other parameters are at stake among which whether part-time jobs are chosen or endured, the significance of children, the ability to choose or not schedules, etc. The role of the socio-professional positions must be tested more precisely: classification trees analysis are only one-step optimal[20], biased in favor of variables having more values and tend to produce both small and large subsets at each split. Log-linear models, especially topological models[21], may help to test the preeminence of the social position over the other variables, hence is the next step of this study.

[20]Currently, tree procedures cannot achieve overall optimality which is too costly in terms of computer resources.

[21]These models enable accurate specifications of the interaction between variables. It should be possible to define different interaction between homogamy and professional organization according to the absolute position of the couples in the social space.

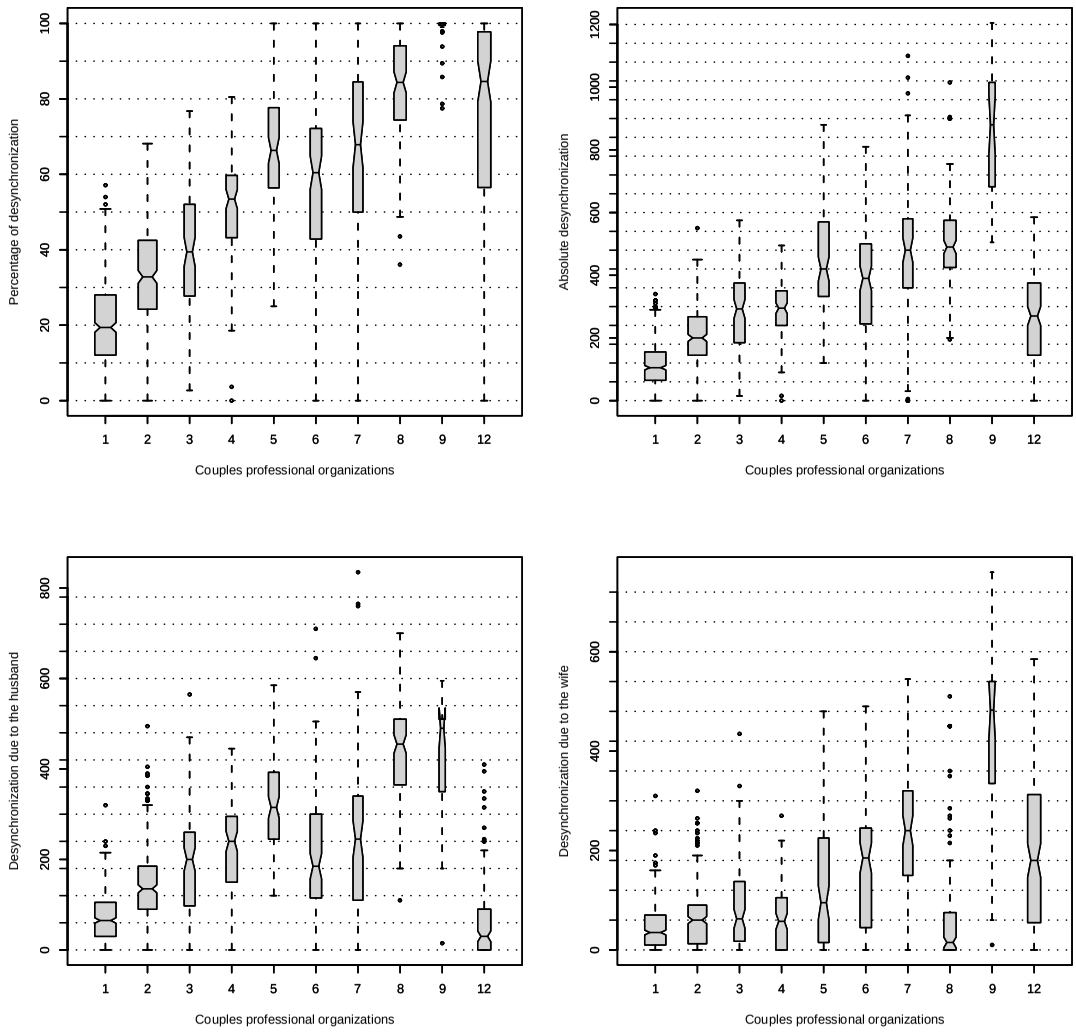

Figure 1: Distribution of various measures of desynchronization according to the work arrangement (the central part of the box represents the median and its vertical extremes the first and third quartiles). Population: 1985-86 couples.

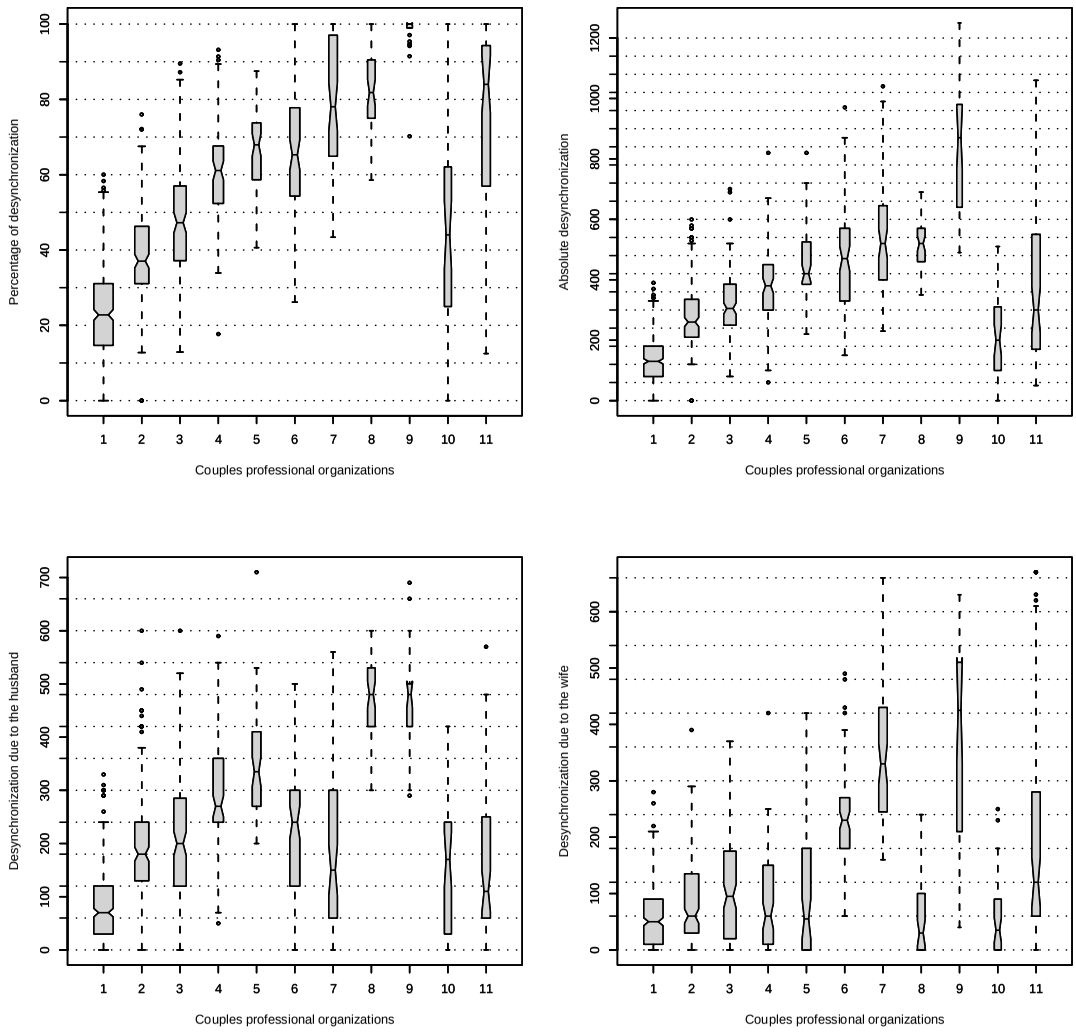

Figure 2: Distribution of various measures of desynchronization according to the work arrangement (the central part of the box represents the median and its vertical extremes the first and third quartiles). Population: 1998-99 couples.

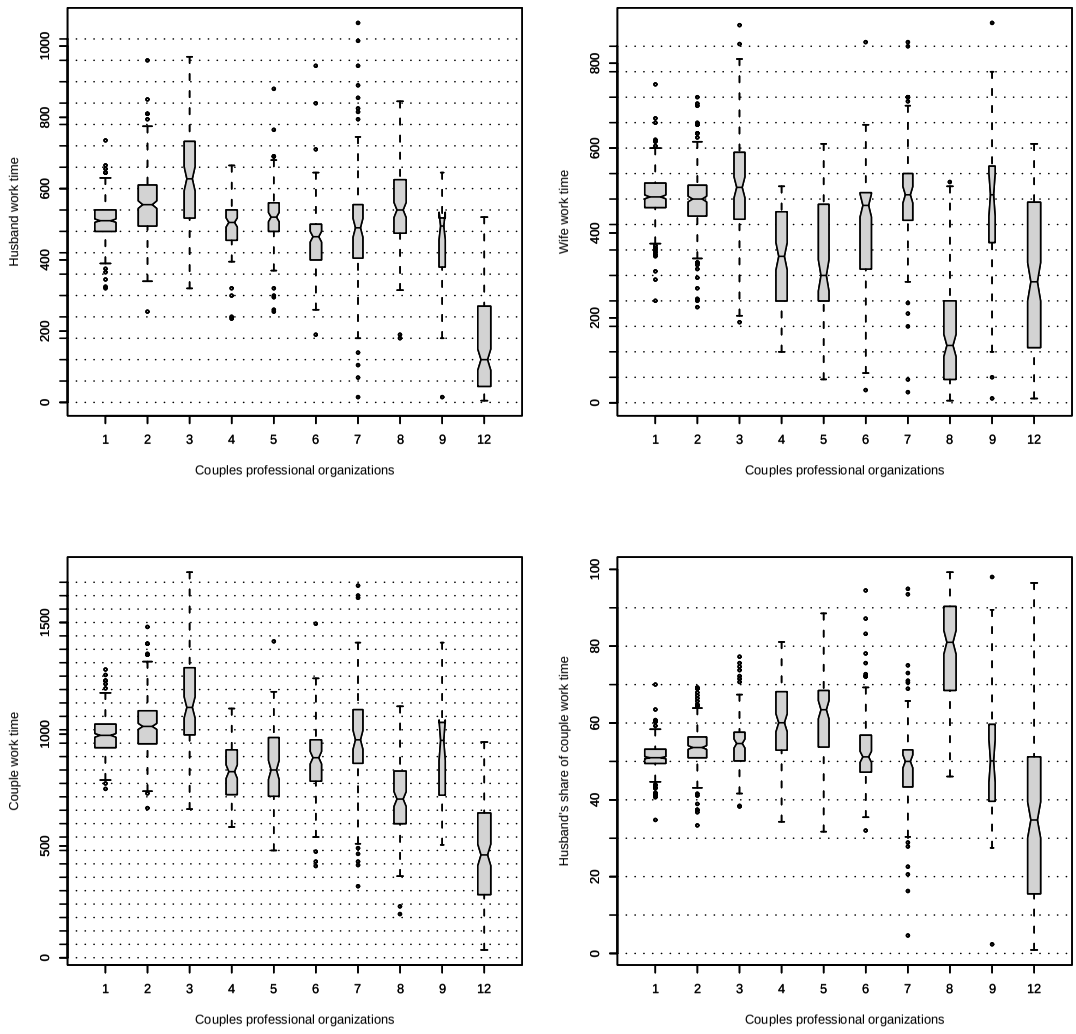

Figure 3: Distribution of various measures of working time according to the work arrangement (the central part of the box represents the median and its vertical extremes the first and third quartiles). Population: 1985-86 couples.

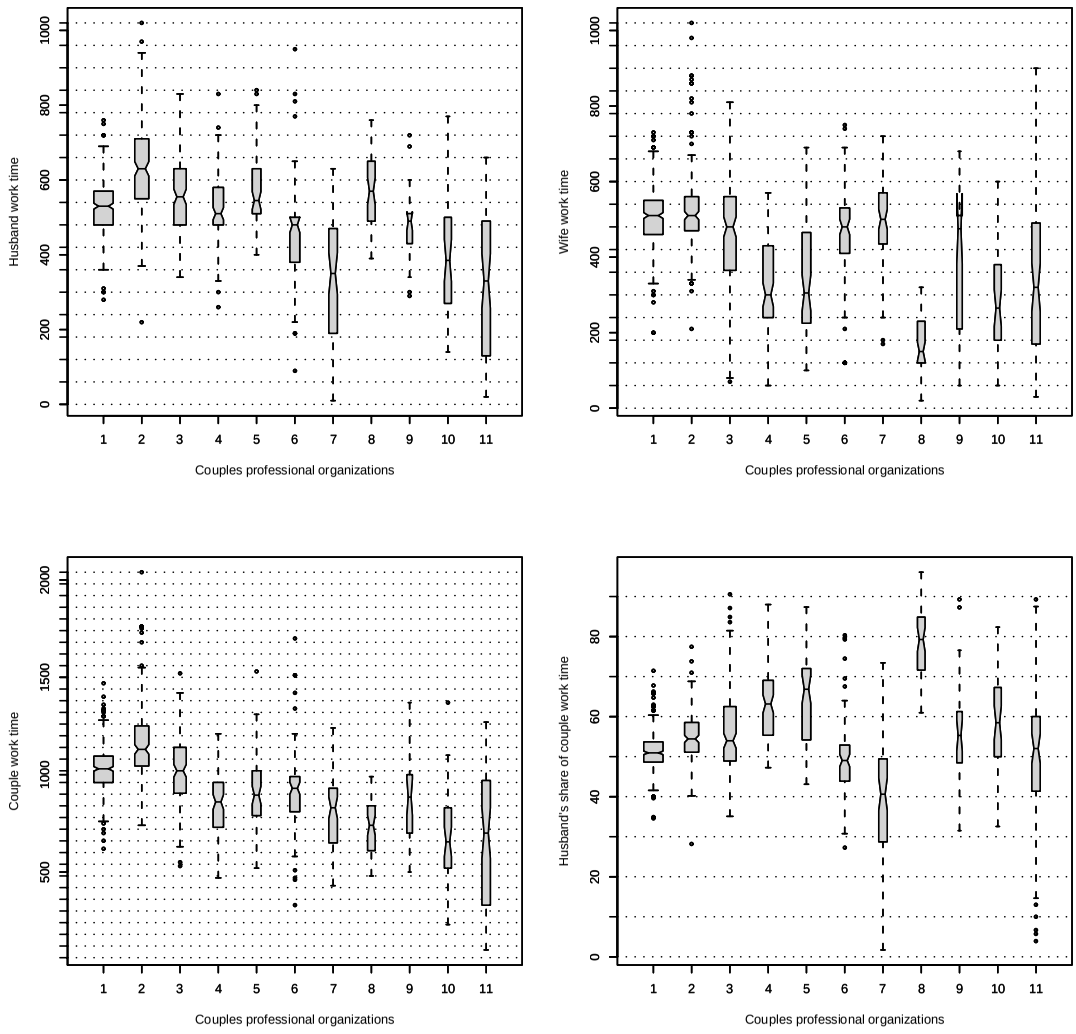

Figure 4: Distribution of various measures of working time according to the work arrangement (the central part of the box represents the median and its vertical extremes the first and third quartiles). Population: 1998-99 couples.

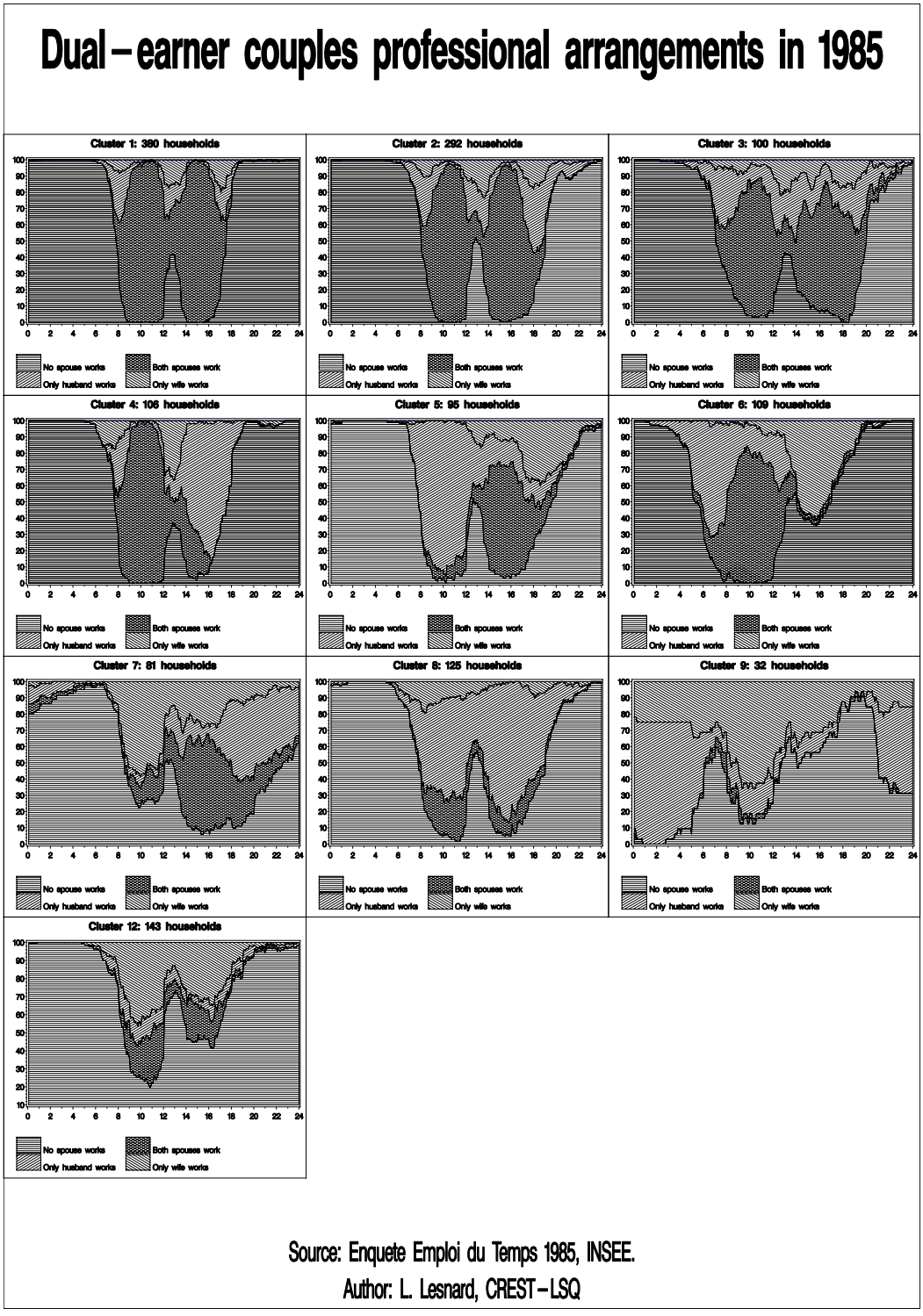

Figure 5: Percentage of couples belonging to the different states for each time-slot. Population: 1985-86 couples.

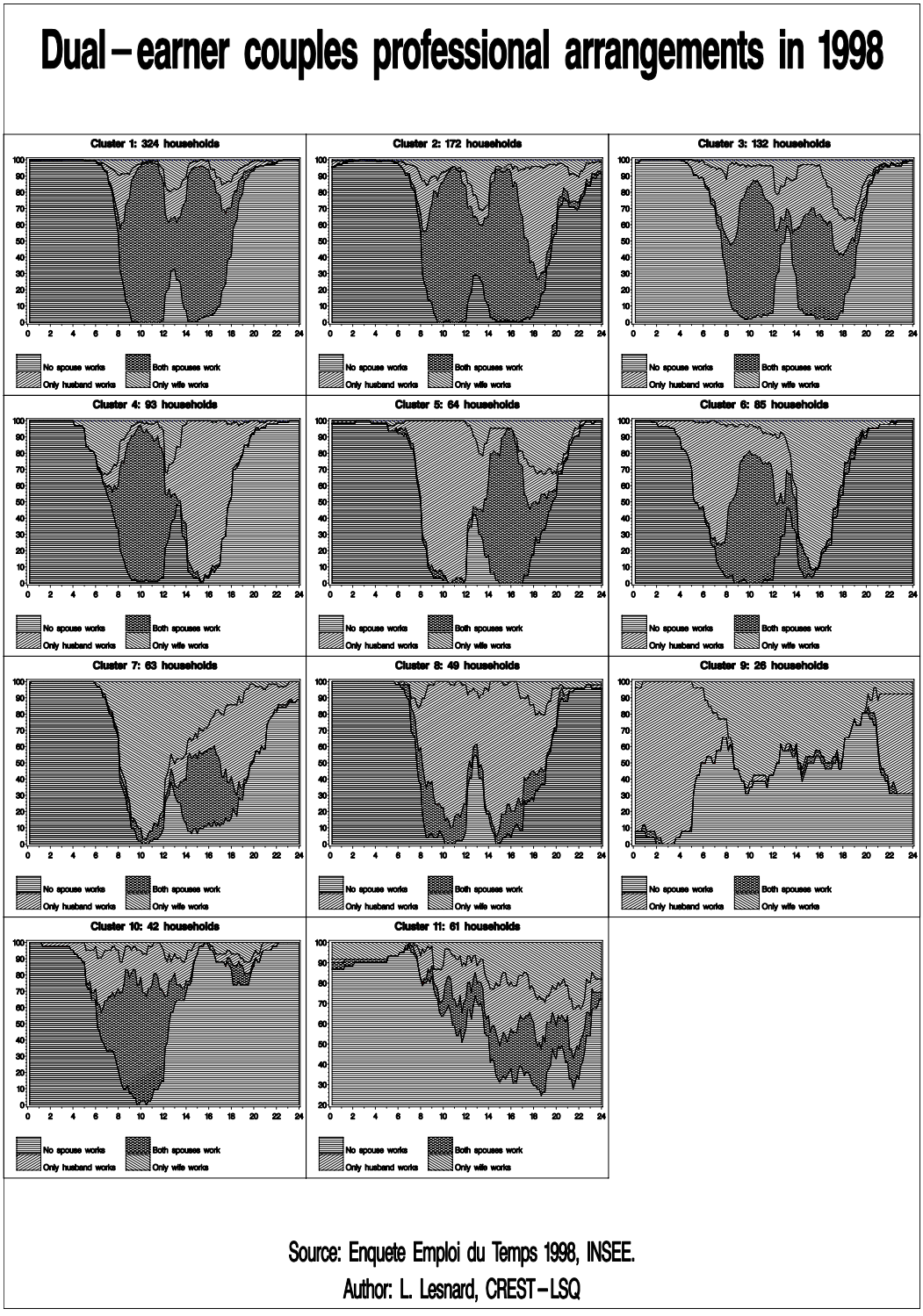

Figure 6: Percentage of couples belonging to the different states for each time-slot. Population: 1998-99 couples.

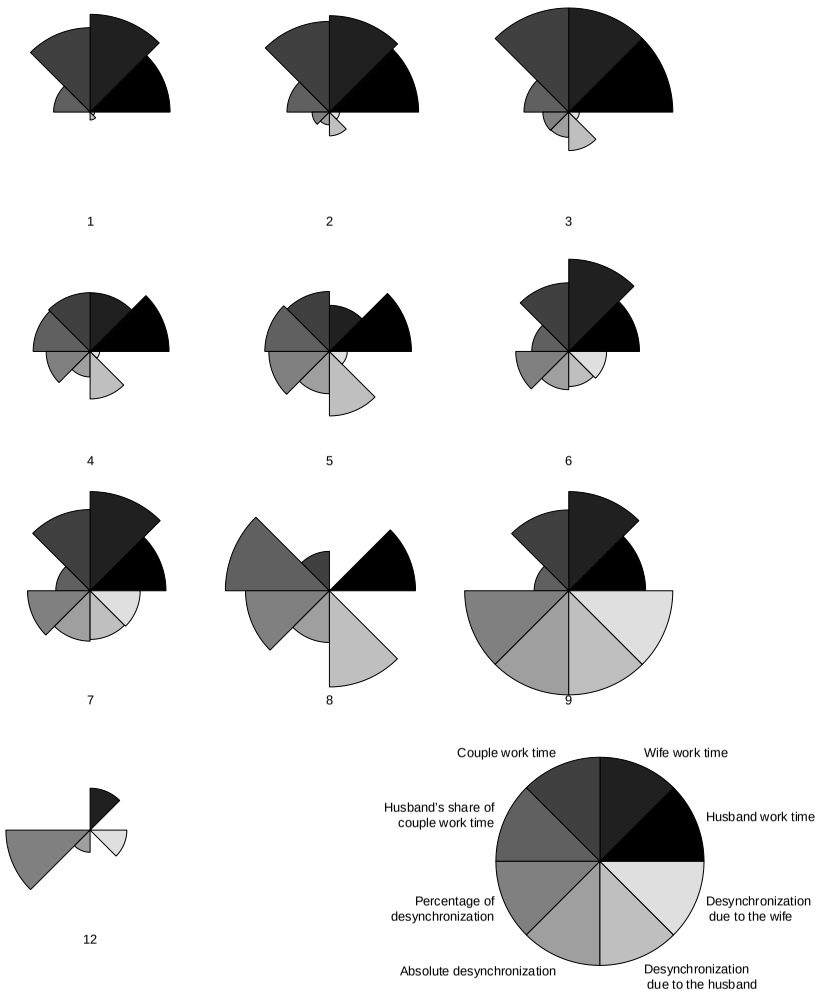

Figure 7: Median star plots of the underlying dimensions of the clusters (the higher the quarter, the higher the median of the clusters relatively to the other clusters). Population: 1985-86 couples.

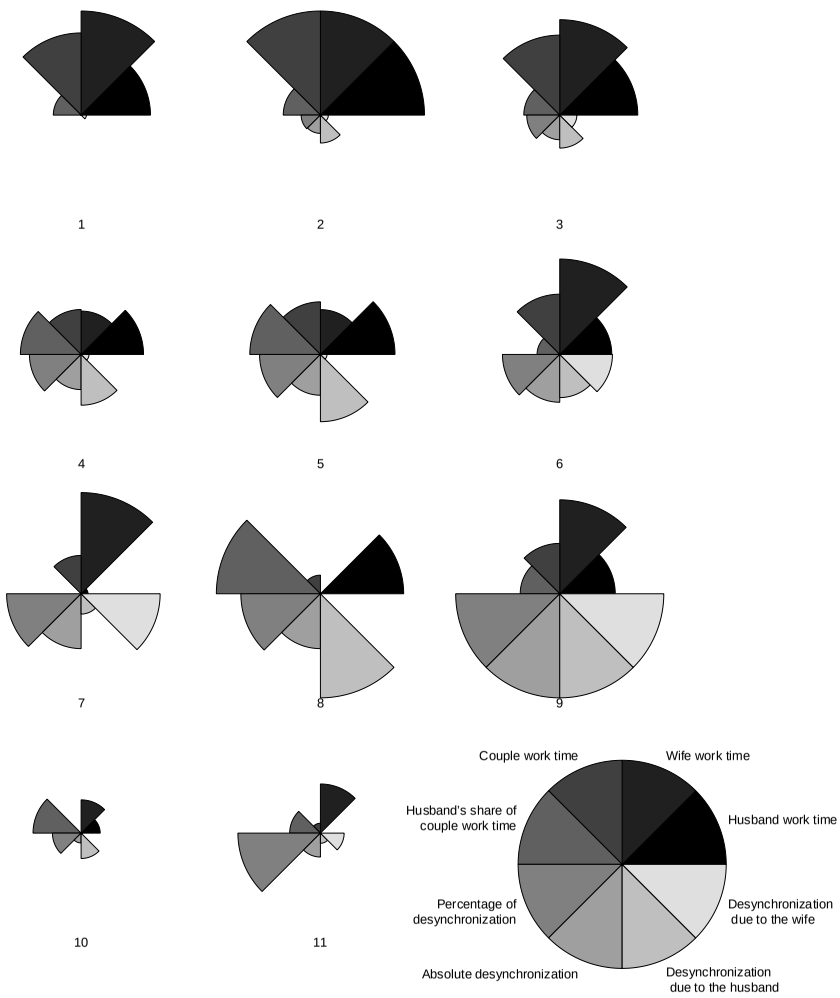

Figure 8: Median star plots of the underlying dimensions of the clusters (the higher the quarter, the higher the median of the clusters relatively to the other clusters). Population: 1998-99 couples.

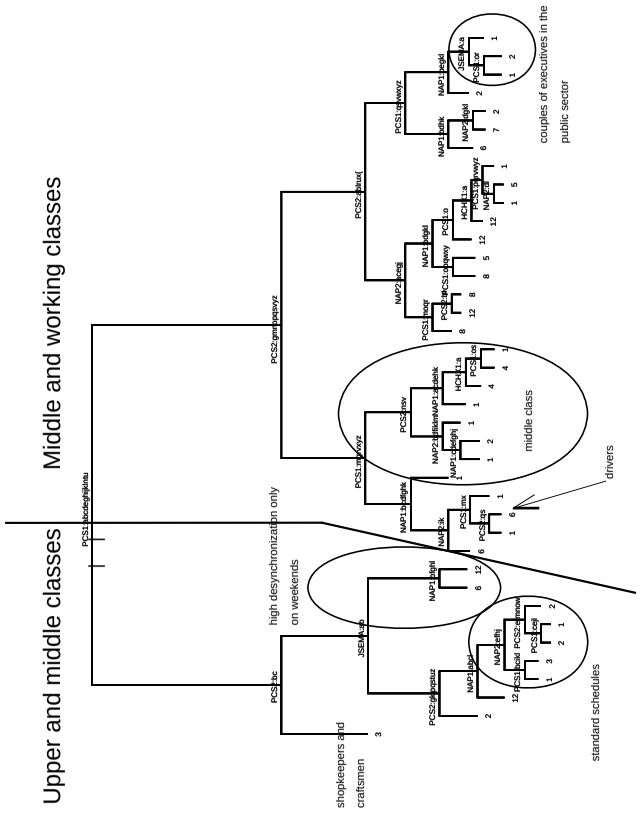

Figure 9: Classification tree based on spouses socio-professional classes, industry, freedom to choose work schedule and the day of the week (misclassification error rate: 52,3 %. The meaning of the letters can be found in the tables 6 and 7 pp. 29-30). Population: 1985-86 couples.

Letter	Social position	Industry
a	Farmers	Farming
b	Craftsmen	Farming industry
c	Shopkeepers	Energy
d	Chief executive	Construction
e	Professions	Commerce
f	Public sector executives	Transport
g	Professors	Finance
h	Journalists, artists	Real estate
i	Private sector executives	Education, Health
j	Private sector engineers	Services for firms
k	School teachers	Services for private individuals
l	Health intermediate occupations	Administration
m	Public sector intermediate employees	Does not know
n	Private sector intermediate employees	
o	Technicians	
p	Foremen	
q	Public sector office employees	
r	Policemen	
s	Private sector office employees	
t	Trade employees	
u	Service employees	
v	Skilled industrial workers	
w	Skilled crafts workers	
x	Drivers	
z	Skilled materials handling workers	
{	Unskilled industrial workers	
}	Unskilled crafts workers	
(	Farm workers	

Table 6: Nomenclature I.

Letter	Day of the week	Schedules
a	Week day without Wed.	Chosen
b	Wednesday	Imposed
c	Saturday	
d	Sunday	

Table 7: Nomenclature II.

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