Sequence Analysis and Transition to Adulthood: An Exploration of the Access to Reproduction in Nineteenth-Century East Belgium

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Abstract		In the population history of European pre-industrial population, late marriage and high level of final celibacy are seen as the most important components of demographic regimes, avoiding an excessive demographic pressure on scarce resources. While during the last decades the scientific approach emphasized the study of individual life trajectories, life transitions are still often considered isolated from each other. In this paper, we look at marriage from an original perspective, as one event on the road to adulthood, whom the position in a given life course is related with other steps like leaving home, establishing a household, and the access to legitimate reproduction through a first birth. Sequence analysis is definitively the appropriate tool for a holistic and integrative approach of the various roads young men and women could take to enter into adulthood. Working on nineteenth century rural regions in East Belgium, we used TraMineR to reconstruct sequences and identified four clusters both for males and females. To complete this exploratory data-mining with an explanatory point of view, we proceeded to univariate ANOVA-like discrepancy analyses of the life trajectories, and then grew a regression tree for our sequences. Results show high level of complexities in rural, supposedly traditional societies, an exercise of individual agency in tolerant but also influent structures that resulted in a high diversity of personal trajectories and a global respect of the social order.

Chapter 8
Sequence Analysis and Transition to Adulthood: An Exploration of the Access to Reproduction in Nineteenth-Century East Belgium

Michel Oris and Gilbert Ritschard

Studying the "Roads to Reproduction" in Historical Demography

Until the Industrial Revolution, within the Malthusian frame, population well-being was always threatened by a 'naturally' excessive demographic growth in a world of scarce resources. To avoid the positive check of mortality, the prudent restraint of marriage appeared as the only efficient option. From the second edition of his famous *Essay* published in 1802, Malthus had this intuition, that was considerably strengthened one-hundred-fifty years later by Hajnal (1965), when the author drew a line going from Saint-Petersburg to Trieste and identified on the west side the so-called *European Marriage Pattern* of late marriage and high proportion of final celibacy. From the 1970s, Peter Laslett and many followers demonstrated that 'nuclear households' were dominant in the West for centuries. In an effort that became decisive for a proper integration of historical demography and family history, Hajnal came back in 1983 with a text on household formation that described the central position of the life cycle service (i.e., a domestic service at teenage and early adult age) in delaying the age at first marriage, while providing various capital to young adults and distancing the generations until young people could reach, at a relatively late age (27–30), a neolocal establishment (i.e., the new-married establishing households of their own, independent from the parental one). However, Todd (1990) showed that in several parts of preindustrial Western Europe, there also

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existed a nuclear family system without life cycle service, as well as stem family societies, a multiple family household system, and some marginal types. This last synthesis has been severely criticized and in 1998, Wall and Fauve-Chamoux explicitly wrote that they could not provide a better alternative and that it was better to give up. The typological approach of family systems had reached a dead end.

This is one of the reasons demography moved from populations to individuals as units of analysis and offered its analytical tools to investigate the associations of behaviors and structures forming processes at various moments of individual life courses, the latter being part of family dynamics according to the 'linked lives' principle (Elder et al. 2003). Recent studies have focused on configurations and living arrangements and used multivariate statistical regressions to identify the factors that explain the occurrence and timing of several transitions along the life course. Life transitions, however, are still too often considered isolated from each other (Kok 2007).

In this paper, we look at marriage and household formation processes from an original perspective. From the previous research, we retain that marriage is still seen as the most important brake to population growth in Western historical populations. However, its interaction with mobility and its role in the household formation must also simultaneously be taken into account. Italian and Spanish scholars have been pioneers of this integrative approach and more explicit while looking at the impact of various migration systems on family lives and demographic regimes. Carlo Corsini (2000, p. 18) concluded:

> Any family system could not maintain itself but through controlling marriage and migration solutions. Migration and marriage appear to be the most sensitive and important factors of family behavior… in historical populations, characterized by 'natural' fertility and when mortality is depending mostly on external elements.

Moreover, all societies have formal and socially accepted events sanctioning transitions from one stage of life to another. Marriage has always represented one of the most important transitions in the individual life course, both in past and in contemporary societies (Hareven and Masaoka 1988). Indeed, we believe that a correct approach to studies on marriage and its role should begin from the fact that in almost every society, marriage has represented the socially accepted access to reproduction, and was consequently an essential precondition for the biological survival and continuity of families and populations. For this reason too, marriage should be seen as a transition point on the 'road to reproduction' and cannot be analyzed for itself, but in relation to other turning points in the life course process of the so-called 'transition to adulthood', i.e., leaving home, family formation, household headship, and inheritance transmission (Shanahan 2000; Dribe et al. 2014, 2010).

Our research sees marriage as one possible event, others being leaving the parental home and first (legitimate) birth, their calendar and successions forming trajectories, or the roads young people could take to access to legitimate reproduction, i.e. to a first legitimate birth. We make use of individual longitudinal data. The settings include rural samples in East Belgium.

Ardennes and the Pays de Herve were the two rural areas in this region, separated by the river Vesdre, on which was located a pioneering centre of the Industrial Revolution in continental Europe: the growing agglomeration of Verviers. The two regions experienced in the first half of the nineteenth century a collapse of their

proto-industrial activities that could not resist to the competition with the modern factories, and a consequent 'ruralisation'. After a period of tensions and decline in economic well-being, the second half of the nineteenth century was a time of betterment, because the excess population emigrated to industrial towns and the growing demand for food from the urban areas benefited the peasants. The agricultural crisis of 1873–1890 just accelerated on-going changes (Neven 2002).

Data and Data Management

Local Sources and Data

Population registers are the original data sources. In a few villages of Ardennes, they were implemented by the local communities to control the right of access to the common lands. From 1846, the Central Committee for Statistics and more specifically its most prominent figure, Adolphe Quetelet, obtained a legal organization and its general use in each Belgian municipality. The basic principle is to start from a population census, to copy the household census sheets in large books, one page per household, one line per individual, and then to start a continuous update. Newborns are added below on their household page and immigrant families are indicated on a new page each; deaths and emigrations are mentioned in special columns; marriages and new households also have to be reported. For each event, the exact date—and when relevant, the location—are indicated. The aim was to have a continuous, complete, and reliable view of the population for statistical and administrative purposes. Theoretically it is a wonderful tool.

In the real world, the succession of additions, new information, new individuals, or new households often resulted in a quite confused document, sometimes very difficult to read and interpret. Moreover, if most of the people moving in took the initiative to declare their arrival in a locality, emigrants regularly just disappeared. In addition, for the local civil servants, this was a register of the living population that they updated more or less regularly, sometimes every four to five months; therefore, newborns who died at an early age tended to be underreported.

The authorities realized that completely replacing censuses with the population registers was a dream. A new census was organized approximately every ten years from 1856, with a new series of population registers reestablished on this reliable base each time. Many rural municipalities, however, wanted to reduce their workload and maintained their population registers over 20 years.

In our databases, we first entered the successive population registers for the nineteenth century. Then we verified the completeness of the marriages, births, and deaths through a comparison with the civil registers. Third, we linked individual records in the successive population registers, so we identified people who 'appeared' as well as those who 'disappeared'. For them, we attributed dates of immigration or emigration using imputation techniques (Alter et al. 2009). We will see below that the results of this long and tedious work are globally excellent.

Table 8.1 Codification of the states in the roads to reproduction

Code	Label	Experienced Events
H	At home	None
LH	Left home	LH
CH	Child at home	FB
C	Child out of the home	LH and FB
MH	Married at home	FM
M	Married	LH and FM
MCH	Married w/child at home	FM and FB
MC	Married w/child	LH, FM and FB

For the purpose of this chapter, we have integrated two samples, one from Ardennes in the commune of Sart (Alter et al. 2004) and one from the Pays de Herve with a cluster of three municipalities: Charneux, Clermont, and Neuchâteau (Neven 2003). We have reconstructed life-sequence data from 1812 to 1900 in addition to the socioeconomic status (SES) of the individuals. SES classification reflects both a simple social structure in the studied villages and the absence of systematic tax information in the Belgian local archives. We could only use the occupation, which is systematically mentioned in our sources, although it implies many missing data for teenagers and women. In our typology, low SES persons are mainly daily laborers and other unskilled workers. The medium SES represents the heart of those rural societies, because this includes the peasants (cultivators, a few farmers). Artisans are in this group in the Ardennes sample and in the low category in the Pays de Herve sample, because in this region, proto-industrial workers faced quite hard times during the studied period as a result of the Industrial Revolution in the neighboring city of Verviers. An upper class (high SES) is present in our typology but has a quite limited demographic weight.

Data Management and Critical Evaluation

The analysis is based on a range of 34 years with annual state sequences from age 12 to 45. The states are defined by three basic events: leaving home (LH), first marriage (FM) and first childbirth (FB). They are defined in Table 8.1. We used TraMineR (Gabadinho et al. 2009, 2011) for managing the sequence data as well as for producing all plots and sequence analysis results shown in this article.

Analyses of the trajectories from leaving the parental home until legitimate reproduction could be severely biased by left censoring, while we dropped all the individuals who experienced one of the three events (leaving home, first marriage, first birth) before they immigrated to our studied villages. When observation started after age 12 and individuals had not experienced any of the events at their first observation, we completed the sequences backward with the state H (Home). Similarly, for cases falling out of observation before age 45 but that had experienced all three events at their last known state, we completed the sequences forward with the

Table 8.2 State to event transformation matrix: Each cell lists the events assumed to occur when we change from the origin row state to the destination column state

	H	LH	CH	C	MH	M	MCH	MC	*
H	"H"	"LH"	"FB"	"LH, FB"	"FM"	"LH, FM"	"FM, FB"	"LH, FM, FB"	"*"
LH	"H"	"LH"	" "	"FB"	" "	"FM"	" "	"FM, FB"	"*"
CH	" "	" "	"FB"	"LH"	" "	" "	"FM"	"LH, FM"	"*"
C	" "	" "	" "	"LH, FB"	" "	" "	"a"	"FM"	"*"
MH	" "	"a"	" "	" "	"FM"	"LH"	"FB"	"LH, FB"	"*"
M	" "	" "	"a"	" "	"a"	"LH, FM"	"a"	"FB"	"*"
MCH	" "	" "	"a"	"a"	" "	" "	"FM, FB"	"LH"	"*"
MC	" "	" "	" "	"a"	" "	" "	"a"	"LH, FM, FC"	"*"
*	"H"	"LH"	"FB"	"LH, FB"	"FM"	"LH, FM"	"FM, FB"	"LH, FM, FC"	"*"

The '*' stands for the missing state and event 'a' corresponds to transitions which were observed in the data but should not occur by definition. Indeed, each state has been calculated at each individual's anniversary only with the information available at the given moment, without considering the individual status before or after that date

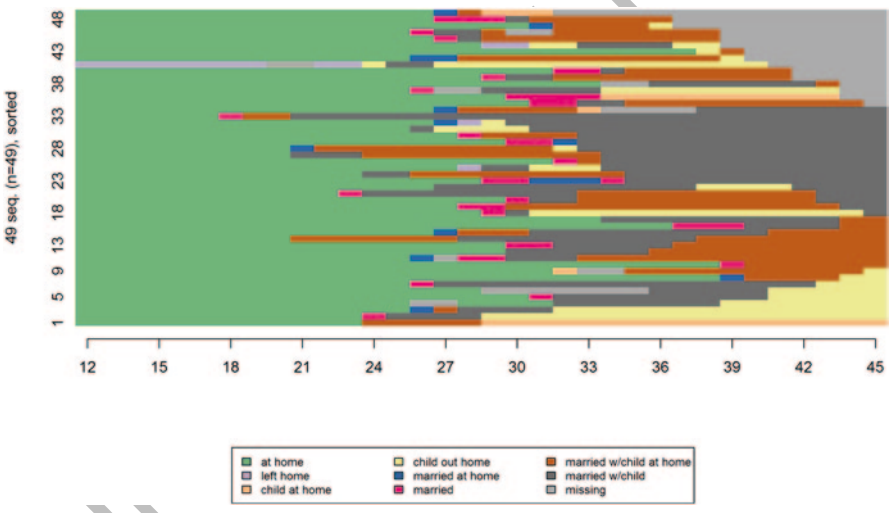

Fig. 8.1 Trajectories with invalid transitions

state MC (married w/child). Then we selected only cases with less than 15 missing states in their sequence. This left 2,511 individual trajectories.

From the state sequences we reconstructed the sequences of original events using the method described in Ritschard et al. (2009) with the transformation matrix in Table 8.2.

We are consequently in a situation where we can make an ex-post evaluation of the data coherence. We found 49 incoherent trajectories, shown in Fig. 8.1, which we dropped out of the following analyses. Considering the complexity of the original data sources, excluding only 1.9 % of the individuals because of inconsistencies

Table 8.3 Distribution of all possible trajectories (%) from living in the parental home to experiencing a first legitimate birth (Nineteenth-century, rural East Belgium)

Trajectories			
N	Types	Men	Women
1	LH-FM-FB	5.7	3.8
2	LH-FB-FM	0.7	0.4
3	FM-LH-FB	9.8	11.1
4	FM-FB-LH	13.8	12.8
5	FB-FM-LH	1.7	3.5
6	FB-LH-FM	0.2	0.7
7	LH/FM-FB	27.9	28.9
8	FB-LH/FM	2.1	3.2
9	FM-FB	33.8	29.6
10	FB-FM	3.9	5.7
11	OTHER	0.2	0.2
	TOTAL	100.0	100.0

demonstrates the high reliability of our documentation, especially if we take also into account that we study here the turbulent years from teenage to adulthood.

The Roads to Reproduction: Cross-Sectional Expectations, First Longitudinal Results

Table 8.3 provides a first picture of the trajectories to legitimate reproduction through a simple alphabet (the one described above in Table 8.1) with an elementary sequential structure (– means a succession, / a simultaneity of events). The results immediately illustrate the many roads young people could take to reach a first legitimate birth in nineteenth-century East Belgium. While the common view is that those rural societies severely controlled the behaviors of the young adults (Servais and Alter 2005; Oris et al. 2014), we observed more than 11 combinations. Moreover, this large variety is accentuated by the absence of a clearly dominant pattern.

Indeed, a first marriage while staying in the parental home, followed for the newlywed by a first birth (trajectory 9, FM-FB) was the most common pattern, but counted for only one-third of the men and a bit less for the women. Moreover, while globally, East Belgium was an area dominated by a culture of a family system without life cycle service, this kind of trajectory is what we expect to find in a very different family system, the stem system, where one children remains in the parental home to receive the inheritance and to become the head of the family. Marriage marks the designation of this heir (or more rarely, heiress) and the new couple cohabitates with the parents until their death (see Fauve-Chamoux and Ochiai 2009 for a more extensive discussion of the stem family system).

The second-most frequent trajectory from the parental home until legitimate reproduction is type 7, LH/FM-FB. Some 28% of the young adults left the parental home when they married, and this neolocal establishment was followed by a first birth. From our previous knowledge based on cross-sectional data, this is what we

expected to be the dominant pattern. We have here a classical illustration of a discrepancy between transversal and longitudinal data. Indeed, in a demographic regime characterized by a late age at first marriage (average age 27 for women, almost 30 for males) and a low life expectancy (around 40–45), cohabitation between a newly married couple and the parents (of the groom or the bride) tended to be short. This implies that when we look at the household structures in the census each ten years, we miss most of those short phases. However, when we use longitudinal data we see that they were indeed frequent in the life courses of young adults as an intermediary phase on their roads to autonomous settlement.

In nineteenth-century rural East Belgium, type 9 was a bit more frequent than type 7. It becomes even clearer if we consider that type 4 (with 13/14% of the trajectories) expresses the same pattern as type 9.

We also note that in 8% of the male trajectories and 13% of the female paths (types 5, 6, 8, and 10) the first birth was an illegitimate one, occurring before the marriage. However, it ended with a formal union, followed by a first legitimate birth. Those high proportions in a nineteenth-century rural context are coherent with a very late age at marriage, which automatically implies an extension of the duration at risk of delivering an illegitimate child (Oris et al. 2014).

We face here rural, supposedly traditional societies with high levels of complexities. At least three results emerge from Table 8.2. First, in a context of demographic pressure (more births than deaths each year) and reduction of the economic opportunities for settling a household ('ruralisation' with the disappearance of artisanal activities and a tendency to fewer but larger farms), young adults who did not emigrate to the industrial towns accessed marriage late and were frequently obliged to cohabit with parents, waiting their death to inherit the farm.

Second, in this highly constrained context, spaces for freedom or human agency existed. Young adults could eventually reach legitimate reproduction through many roads. An international team calculated the measures shown in Table 8.2 for preindustrial settings in Sweden, Italy, and Japan and the comparison demonstrated the higher liberty of the young living in nineteenth-century rural East Belgium (Dribe et al. 2010).

Third, freedom was both obvious and relative, because around one in ten broke the religious and legal rules and had an illegitimate child. They regularized their situation later. This pattern demonstrates the ability of the local societies to integrate some marginal trajectories and reconstruct a threatened social order.

More globally, this is also an expression of the tensions between parents and their adult children, between rural communities and their young adults, between the local notables and the lower classes (daily laborers). On one hand, at a community level, preserving the balance between population and scarce resources implied delaying the access to reproduction and at an individual/family level to oblige the fiancés to wait for an economic unit to become available before marrying and settling in a household of their own. On the other hand, young adults had to wait for long periods and sometimes used premarital sexual relations to impose their own choice of a partner and/or obtain an early marriage. We know that many brides were pregnant when they married, because some 40% had a first birth in the eight months following the wedding (Oris et al. 2014).

Sequence Analysis of Access to Legitimate Reproduction

Although those first results are of great interest and already represent a decent contribution, two limitations have to be immediately acknowledged. First, we just observed the sequences between the events but not the status duration. In other words, two 'roads to reproduction' that followed the pattern LH-FM-FB could seem exactly the same. However, it is possible that one left home at 14, stayed in life cycle service for 15 years before a marriage at 29, while for the second, those values could have been 18, 2, and 20, respectively.

Second, if we cross-tabulate the possible trajectories to first birth with a pertinent variable, socioeconomic status for example, we face a multitude of little numbers that are difficult, if not impossible, to interpret. And without considering the timing of events and social position variables (e.g., SES), our approach to the articulation of individual trajectories with social and demographic regulations remains superficial. Especially, we do not see how the individual dynamics, or relative individual freedom, resulted in a global adjustment between demographic trends and economic resources at a community level. Capturing this articulation is crucial to our understanding of the delicate trade-offs observed in all the previous studies on preindustrial Western societies. In the next pages, we show that sequence analysis emerges as a highly relevant tool to reach this objective.

The series of cross-sectional distributions in the top panels of Fig. 8.2 shows that both males and females exhibited a pattern typical of a nuclear family system without life cycle service. The 'left home' status seems almost absent. From 'at home' (being at home, single, without children) to 'married w/child' (married with child in a household of his/her own), only a limited area of transitional statuses appears. Women experienced their transitions younger than men; otherwise the figures for males and females are very similar.

However, below the series of cross-sectional distributions are also drawn the index-plots, which add relevant information by depicting the individual trajectories and their diversity. The statuses associated with stem phases of cohabitation ('child at home', 'married at home', 'married with child at home') are more frequent at higher ages and more frequent among men than women. The first observation supports the interpretation that those people stayed with their parents because they waited for their inheritance of the family property. From a legal point of view, women were not disadvantaged during the successions, but brothers usually compensated their sisters, so the transfers tended to be in the male line.

We conducted a second separate cluster analysis for males and females using optimal matching (OM) pairwise dissimilarities between the sequences. Since the states were derived from the experienced events (leaving home, first marriage, first birth), we used substitution costs reflecting the number of mismatches on events characterizing each state, i.e., the Euclidean distance between the rows of the property (see Table 8.4).

We set the indel cost as half the maximum substitution cost.

We obtained the clusters by partitioning around medoids (pam) (Kaufman and Rousseeuw 2005; Studer 2013). Examining the range of solutions for k = 2 to 10

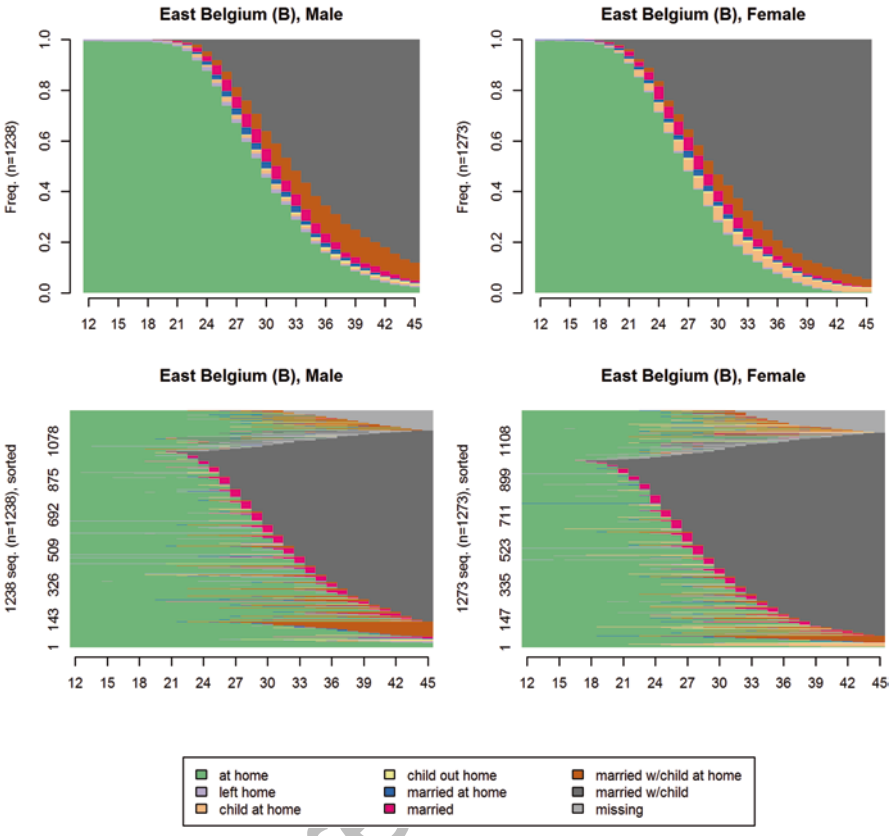

Fig. 8.2 Plots by sex. *Top*: Time evolution of cross-sectional distributions. *Bottom*: Index-plots sorted by state from right to left

Table 8.4 State properties in terms of occurred events

	Left home	Married	Birth
H	0	0	0
LH	1	0	0
CH	0	0	1
C	1	0	1
MH	0	1	0
M	1	1	0
MCH	0	1	1
MC	1	1	1

groups, the four-group partition appeared to be, for men as well as for women, a good compromise solution regarding a series of partition quality measures. The average silhouette width of the four-cluster solution is .38 for men and .35 for women and the R^2 (proportion of explained discrepancy) respectively 45 and 47% (see for

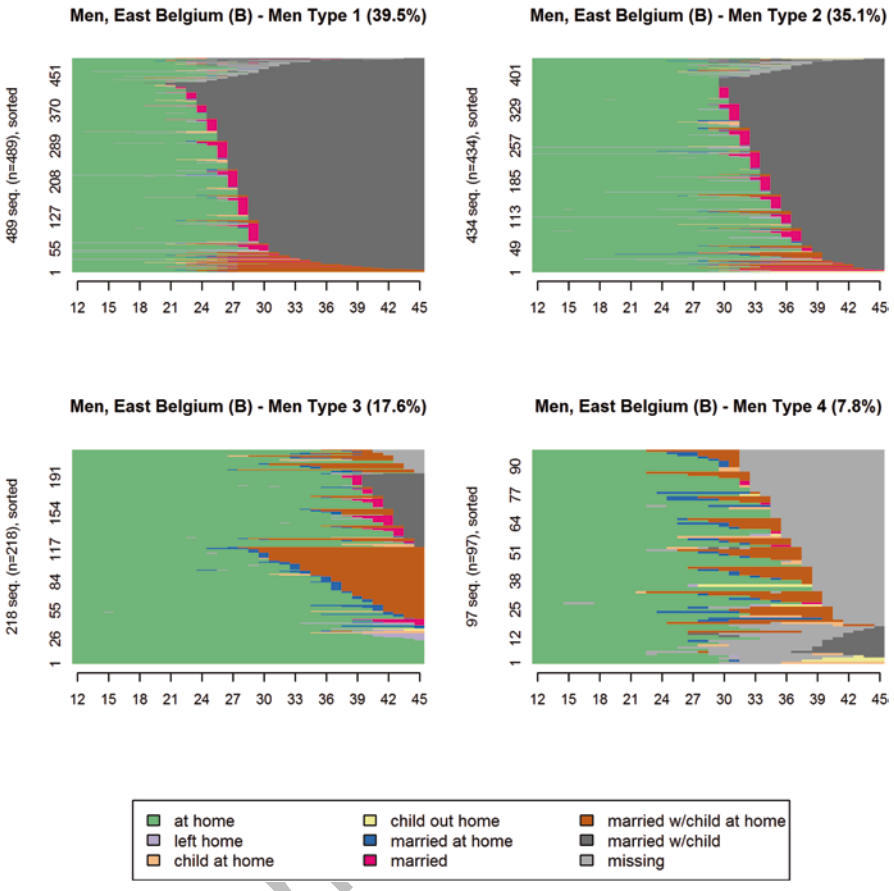

Fig. 8.3 Clusters of sequences. *I-plots, sorted by state from right to left*. Men

example Studer 2013 for details about the measures). The obtained clusters are visualized with index-plots in Fig. 8.3 for men and in Fig. 8.4 for women. The advantage of well-sorted index plots over chronograms is that they render the discrepancies within the clusters in addition to the between-clusters differences.

Among men (Fig. 8.3), the timing of transitions to adulthood is the discriminating factor for the three first groups. Indeed, while the average age at first legitimate birth for males was around 32 (with a median at 31), type 1 brought together almost 40% of the trajectories, with this transition observed at 27 on average. For type 3, with 17.6% of the male population, the turning point was very late (mean = 38.64 with the median at 40). Type 2 (35%) was close to the global male average values (Table 8.5). Finally a little group (less than 8%) brings together people who emigrated from the villages at some moment in their life trajectory, creating situations of right censures and consequently missing information.

Tamara Hareven explained at which point marriage and the access to reproduction are normative transitions, especially with a 'proper age at marriage' and social

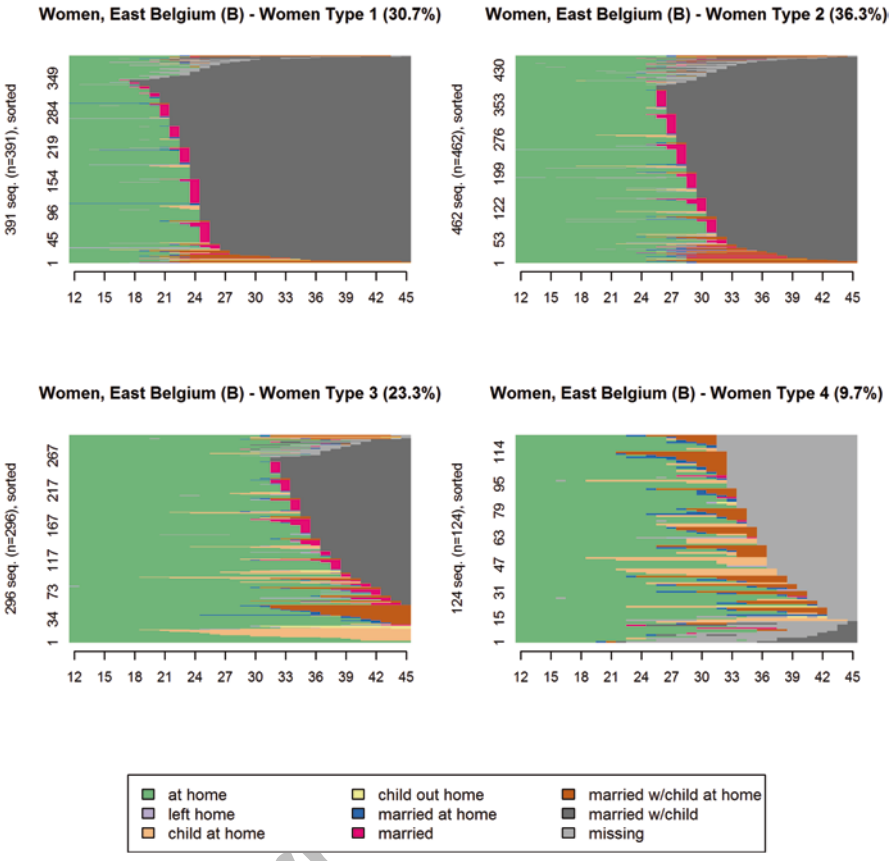

Fig. 8.4 Clusters of sequences. *I-plots, sorted by state from right to left*. Women

Table 8.5 Age at first legitimate birth, by sex and cluster

	Men				Women			
	Median	Mean	Sd	Cv	Median	Mean	Sd	Cv
Type 1	27	27.23	2.68	0.10	24	23.75	2.25	0.09
Type 2	34	34.09	2.87	0.08	29	29.44	2.31	0.08
Type 3	40	38.64	4.35	0.11	36	36.54	3.48	0.10
Type 4	31	32.57	5.27	0.16	31.5	32.12	5.21	0.16
Total	31	31.75	5.31	0.17	29	29.33	5.51	0.19

stigma on those who did not experience the transition at the right time, both the young (suspected of sexual debauchery) and the 'old' unmarried (named old spinsters, old bachelors and seen as the 'residuals' from the matrimonial market, the 'untaken') (Hareven and Masaoka 1988). Those social representations are strong enough to create a survival curve for first marriage and childbirth which has a first

plane segment (everybody unmarried without child), followed by a brutal decline during a short period (more or less ten years) during which most of the marriages and first births happen (i.e. the proper age), then a new flat portion at a lower level once the proper age is passed and those who did not succeed in making the transitions during the typical period of their life course have no other choice than final celibacy and taking care of their nephews or nieces (Oris and Ochiai 2002).

Here we observe a clear distinction between a significant proportion (almost 40 %) of young males who broke the secular pattern of late marriage and were pioneers of a modernization of the household formation rules in those remote rural areas of East Belgium (type 1), versus those who respected the norms and married late (type 2), while a little group avoided final celibacy and biological extinction at the very last moments (type 3). Those results are quite original and unexpected. Although one of the two authors of this paper has worked on those populations and databases for more than 20 years, he never suspected the existence of this group 3 of very late access to parenthood, those who reached the objective largely after the proper age.

Index plots show that the stem family phases were present everywhere but clearly more in this type 3. It suggests once again that those men waited for their inheritances and faced the ambivalent situation of seeing their parents surviving until they were old enough that they lost their power and authorized their waiting boy to finally access marriage and reproduction. The sons then took the headship of the household and family business and cared for the elderly parents until their deaths. This kind of transfer, when both generations were still alive, was not known till now in nineteenth-century rural East Belgium but has frequently been observed elsewhere in Europe at the same time, especially in the Scandinavian countries (Dribe 2000). In our case, it becomes a new reasonable interpretation that will require further investigation in the archives, mainly in the notarial acts. However, we will see below that a complementary explanation also emerges.

The female pattern (Fig. 8.4) was similar, with the first 31 % of women transiting early, around 24, and abruptly, with a little coefficient of variation around the mean (see type 1 on Fig. 8.4 and Table 8.3). Some 36 % had a late transition around 29 (type 2), and 23 % a very late transition to motherhood around 36 or 37 (type 3). Once again, type 4 brought together the cases with missing information on the right; they are less than 10 %. In that group, we see the trajectories of unwed mothers. The yellow colour means they were isolated from their parents and were very probably not old-rooted members of the local communities. Eventually they emigrated after their pregnancies to escape from the public shame, to go back to their own native communities, or to search for a new life in the industrial towns. We also see some yellow lines in the other clusters, designating the few who obtained marriage and regularization.

But in cluster 3, a block of orange lines is concentrated. It represents the unwed mothers who lived with their parents. Their kin were not always able to constrain the gallant to do his duty, but those women were not rejected by their parents. In cluster 3, we also see the stem family phases—less frequent than among their male counterparts, however, for the reasons already discussed above.

Table 8.6 Univariate discrepancy analysis

	Categories	R^2	F	Sig.
Sex	2	0.018	47.2	0.000
Modal SES	4	0.014	11.9	0.000
Last SES	4	0.009	7.9	0.000

Relationships Between Trajectories, Socioeconomic Status, and Sex

From the previous analysis, it seems that only timing really distinguished men and women with transitions two to three years earlier for the latter. We wanted to verify this interpretation of the figures statistically, but also to see if the observed clusters and therefore the internal variance within the local community could be explained by SES. Indeed, when Thomas Malthus (1803/1992) explained in his essay that the poor were unable to control their sexual appetites, married too early, and made more children than they were able to raise—children consequently condemned to poverty—he just expressed an idea widely shared by the elites of his time all across Europe, including in East Belgium (Alter and Oris 1999; Neven 2003). A more recent and less moral interpretation is that landless had no land or patrimony to protect, and they could not use their children to work on land they did not have. Parents thus had no rationale to delay the leaving home and marriage of their children (Oris et al. 2014). That is why we suspect cluster 1 (both for males and females) brings together trajectories of young adults from the low SES, from daily laborer families.

To test those hypotheses and see at which point sex and SES explained the diversity in timing and household formation rules, we first proceeded to a univariate ANOVA-like discrepancy analysis (Studer et al. 2011) for each of the variables: sex, most frequent SES in the sequence, and last SES in the sequence. The results, shown in Table 8.6, demonstrate that sex and SES explain only a small but statistically significant part of the discrepancy between trajectories. The most frequent SES looks more informative than the last observed SES.

We then grew a regression tree for our sequences (Studer et al. 2011). Regression trees are obtained by searching first among the covariates for the one that permits the best binary split, i.e., the split which explains the biggest part of the discrepancy and therefore generates the highest R^2. This operation is then repeated locally at each obtained node. The growing stops when the split is not significant. We used a 0.5 % p-value limit and set the maximum tree depth as 4.

As shown in Fig. 8.5, sex explodes the initial root and divides the male and female trajectories. Rules and distributions were, however, quite similar; only the more precocious timing of the women made a real difference. Among men, the splitting procedure separated the few males without occupation and the daily labourers from the peasants and the modest local elites (the middle class). The former had more abrupt and earlier transitions, which tends to confirm the interpretation that daily labourers were freer to marry because they did not have land or patrimony

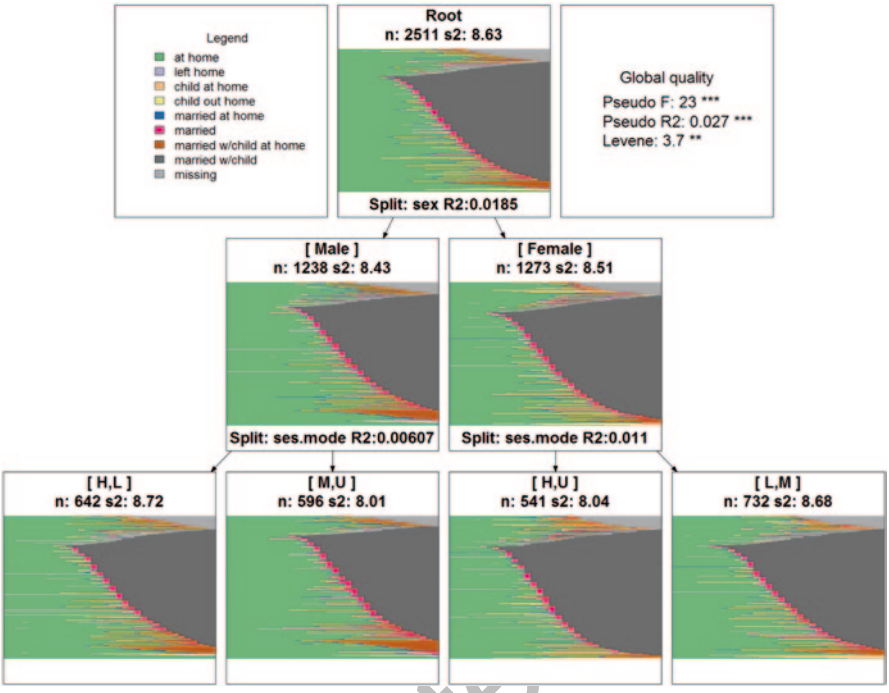

Fig. 8.5 Sequence regression tree. I-plots, sorted from end

to preserve. We find a confirmation of the whole process of transition from leaving the parental home to legitimate reproduction.

However, on the female side, we do not find the same separation. On one side are the few women from the upper classes and those who did not declare an occupation, which was a part of the nineteenth century culture of respectability among the middle classes. On the other side are together the medium (peasants) and low (daily labourers) SES. Moreover, if we look at the average age at first legitimate birth and the variation coefficient (Cv) around this mean, we see few differences between the leaves (terminal nodes of the tree) and we observe a large standard deviation (sd) within each of those leaves (Table 8.7). This is confirmed by the low pseudo R^2 of only 0.027 (Fig. 8.5, Global quality) for the final partition into four leaves, meaning that the tree explains only 2.7% of the total discrepancy.

However, I-plots from the tree provide new information. Indeed, the phases of cohabitation with grand-parents are also present among the men of low SES who had nothing or little to leave as an inheritance. Going back to the original data, we observe a pattern which is not a stem pattern but an adaptation of the nuclear family rules. Indeed, newly married couples with children welcomed a widowed parent in their household, usually a grand-mother. The latter was not abandoned in an 'empty nest' and probably took care of the grand-children so that the mother could work more (Oris and Ochiai 2002).

Table 8.7 Age at first legitimate birth, by leaf of the tree

	Median	Mean	Sd	Cv
Male, H or L	30	31.08	5.33	0.17
Male, M or U	32	32.48	5.19	0.16
Female, H or U	28	28.23	4.98	0.18
Female, L or M	30	30.16	5.74	0.19

Conclusion

The main objective in this chapter was to look at internal variances within the population considered. We also wanted to explore the relationships between family systems and socioeconomic structures through an analysis of longitudinal individual-level data. Using optimal matching to analyze the trajectories systematically, and then cluster analysis and a regression tree to classify them, we demonstrated that internal variations are important to understand a social and economic organization. It appears that a system is a combination of individual differences in behaviors.

Peasants and daily laborers from Ardennes and the Pays de Herve lived in a demographic regime dominated until the end of the nineteenth-century by a very late age at marriage. In a context of uncontrolled fertility, it was the only solution to reduce the family size. However, this global pattern was created by an impressive diversity of trajectories, a diversity that illustrates the importance of individual agency in a highly constrained context for those who decided to stay in the villages. The completely unexpected discovery of a group, both on the male and the female sides, able to triumph over the norm of a proper age at marriage—moreover, in a demographic regime where marriage played such a crucial role—proves the performance of the data-mining techniques (Ritschard and Oris 2005). We were so structured by the literature and previous results that we simply never looked at those people until they appeared in group 3 of Figs. 8.3 and 8.5. A new narrative became part of the story as a whole.

This contribution also shows the point at which the usual approach of household structure or living arrangements can hide the complexity of the real world and real life trajectories. If we come back to Fig. 8.2 (Top), we face an ideal type: a proto-nuclear family system without life cycle service. But looking inside, we discovered that on the roads to reproduction, men and women could respect various set of rules, and that an internal diversity could be demonstrated and measured. In East Belgium, the internal diversity was striking, mainly due to variations in the timing of transitions in the former case. We investigated the impact of sex and SES; however, the statistical evaluation of our decomposition shows that the larger part of the individual variability is not captured by those variables.

According to Buckx (2009), the transitions of youth into adulthood cannot be fully understood if the parental-children relations are not properly taken into account. Our own results about the cohabitation with parents and grand-parents, resulting from a stem family logic or from an adaptation of the 'nuclear' family rules,

support this view. Moreover, previous analyses of leaving home and first marriages using event-history methods demonstrated the importance of the young adult's position in their sibling group (Alter and Oris 1999; Bras and Neven 2007). The next methodological and substantial challenge will be to properly consider those linked lives dimensions.

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