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MATE CHOICE IN OLIVENZA: INFLUENCE OF BORDER CHANGE ON SPANISH–PORTUGUESE LINEAGES

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Summary. The mating pattern in a population determines the next generation gene pool and therefore its genetic structure. Besides socio-cultural and geographic factors, political barriers may influence the formation of couples. The present paper studies how the change of national border affected the mating pattern of Olivenza in Badajoz Province (Spain), which experienced a change of domain from Portugal to Spain in 1801. For the period analysed (1750–1850), 954 Catholic marriage records were transcribed. Data were sorted by decades in order to make a temporal study possible and analysed by means of diversity and repeated-pairs of surnames. Following the change of border the mating pattern modified. Coinciding with a larger number of mixed marriages with Spaniards, there was a progressive rise in the diversity of surnames. From 1811 to 1820 the analysis of repeated-pairs of surnames indicates the existence of preferential matings within Spanish and Portuguese lineages. After 1821 the above pattern became less clear due to the disappearance of the Spanish–Portuguese restrictions on choice of mate.

Introduction

The genetic structure of a population depends on demographic, geographic and socio-cultural factors. Language, ethnicity, religious affiliation and occupation are variables that have been analysed (Smith *et al*., 1984; Koertvelyessy *et al*., 1988; Vienna & Biondi, 2001; Manni *et al*., 2004; Biondi *et al*., 2005; Tagarelli *et al*., 2007).

A differential mating pattern may be detected from information on birth and residence places of mates as well as from their surnames. The frequency and

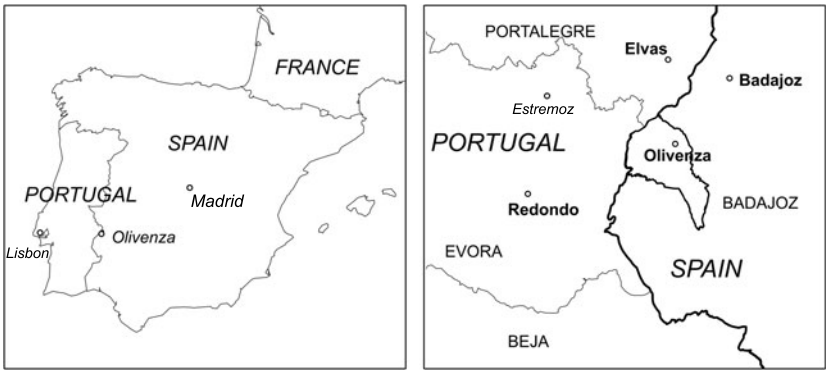

Fig. 1. Olivenza location (in dashes the present-day limits of the municipality of Olivenza, which coincide with the border between Portugal and Spain before 1801).

distribution of surnames studied by means of isonymic analysis provide insight into the genetic structure of populations (Caravello & Tasso, 1999; Boattini *et al*., 2006; Tagarelli *et al*., 2007) and the relation of the above to the geographic origin of individuals (Smith & Bittles, 2002; Sanna *et al*., 2006).

Mating preference between certain lineages (Ridley, 1996) influenced by religion (Koertvelyessy *et al*., 1988, 1992), or geography and ethnicity (Koertvelyessy *et al*., 1990; Pettener *et al*., 1998) determines population subdivision. Furthermore, geographic or socio-cultural barriers to mate choice exist in some populations. One of the methods that make possible the detection of these barriers is the analysis of repeated-pairs of surnames. This method, developed by Lasker & Kaplan (1985), quantifies the combination of surnames of couples. The analysis of repeated-pairs of surnames reveals possible subdivisions of a population (Wahlund effect) made up of genetically isolated subpopulations (Wahlund, 1928). It has the advantage over other classical methods of isonymy analysis of allowing the detection of preferential mating patterns, but it is unable to identify the factors that produce this phenomenon (Biondi *et al*., 1996). Subdivisions may be detected when more repeated-pairs of surnames are observed than expected (Chakraborty, 1985; Lasker & Kaplan, 1985; Lasker, 1988; Relethford, 1992).

A political border may also constitute a barrier limiting mating, and therefore the gene flow between populations. Several studies considering nationality have been based on surnames, such as those of Bolsen & Lasker (1996), Riegler *et al*. (2007) and Scapoli *et al*. (2007). Concerning previous studies on mating patterns in Spain and Portugal, Pallarés (1990), Abade (1992), Macbeth *et al*. (1996) and González-Martìn & Toja (2002) considered communities close to the Spanish border, but only the study of Eizaguirre (1994) on some trans-frontier parishes at the northern Spanish–Portuguese border and based on surnames and places of birth and residence, is relevant to the present research.

In order to determine the effect of the change of national borders on the biodemographic structure of a population, the Spanish village of Olivenza in Badajoz Province (Fig. 1) was chosen as a case for study. Since the 13th century this village

experienced alternate changes of domain between Portugal and Spain. In 1801 Spain and France declared a war on Portugal which ended with the signature of the 'Treaty of Badajoz' incorporating definitively Olivenza to Spain.

The municipality of Olivenza is located 24 km west of the provincial capital (Fig. 1) and occupies an area of 42,206 ha. The number of inhabitants during the period studied (1750–1850) is known only according to the censuses of 1801 (6737) and 1842 (6291). However, the comparison of these two population counts is not possible because although the 1842 census reflects the population officially inscribed, no details are given for 1801 regarding the legal or actual residence.

By using data on marital migration and diversity of surnames, the present study determines whether the modification of the border had a gradual or immediate influence on the mating pattern of Olivenza. Furthermore, by means of an analysis of repeated surname pairs, this investigation quantifies the process of mate choice in Olivenza related both to the change of sovereignty and eventually to the existence of population subdivision between Spanish and Portuguese lineages.

Methods

Information on all the available Catholic marriages (N=3954) celebrated in Olivenza during the period 1750–1850 was obtained. A copy of the ecclesiastical registers kept by the Church of Latter-Day Saints provided data on surnames of spouses and their parents, as well as their places of birth and residence.

Couples married in Olivenza were classified according to the geographical origins of males and females: Olivenza, Spain and Portugal. In order to identify differences in birthplaces coinciding with the change of border, data referring to two periods were compared: one 'before' the change of domain (1750–1800) and the other 'after' the change (1801–1850). Furthermore, a more detailed analysis dividing these data into ten consecutive periods was made (1750–60, 1761–70, 1771–80, 1781–90, 1791–1800, 1801–1810, 1911–1820, 1821–1830, 1831–1840 and 1841–1850). In both cases the corresponding frequencies were compared by means of a χ^2 test for homogeneity of samples.

Orthographic variations found in some surnames could be attributed to linguistic differences between Portuguese and Spanish. It was therefore difficult to distinguish polyphyletic surnames from those that presented Portuguese and Spanish spelling variations despite their common origin (Faure *et al*., 2001). In order to correct possible bias because of surnames' orthographic variation, standardized spelling of surnames (i.e. Rodriguez=Rodrigues) was retained.

In the period considered, the Portuguese system of transmission of surnames was not consistent and distinct from that of Spain, which was formed by a first surname of the father and a second of the mother. To check the pattern of surname transmission in Olivenza, the correspondence of surnames of mates to their parents was determined by means of an analysis of frequencies comparing the surnames of grooms and brides with those of their respective parents. Data providing more valid cases and better correspondence between generations were used: for grooms the first own surname and for brides the first surname of their fathers (Román *et al*., 2007).

The method applied to estimate the diversity of surnames in each period was the H index (Shannon & Weaver, 1949):

$$H = -\sum_i p_i \ln(p_i)$$

where p_i is the probability of the i^{th} surname in each period.

In order to estimate immigration into Olivenza contemporary with the change of border, the proportion of surnames counted only once (A) was obtained following Rodriguez-Larralde & Barrai (1998). Pairs of surnames in Olivenza were compared according to the Lasker & Kaplan (1985) method, which determines the proportion of pairs of observed surnames to random pairs.

The frequency of repetition of each pair of surnames is measured by RP, which is defined as:

$$\mathrm{RP} = \left[\sum_i \sum_j S_{ij}\left(S_{ij} - 1\right)\right] \Big/ N(N-1)$$

where S_{ij} is the number of couples with male surname i and female surname j, and N represents the total number of marriages ($N=\Sigma_i\Sigma_j S_{ij}$). This index may take values between 0 (each pair counted once) and 1 (a combination of surnames is repeated N times).

The observed values (RP) were compared with the index of repeated-pairs expected at random ($\mathrm{RP_r}$), corresponding to a situation in which the number of repetitions depends only on the frequency of different surnames existing in the population. $\mathrm{RP_r}$ was calculated following Chakraborty (1985):

$$\mathrm{RP_r} = (S_i^2 - N)(S_j^2 - N)/N^2(N-1)^2$$

where S_i^2 and S_j^2 are the squared number of surnames for grooms and brides, respectively, and N is the total number of marriages.

The percentage of excess RP over the random expectation was calculated according to Relethford (1992):

$100(\mathrm{RP}-\mathrm{RP_r})/\mathrm{RP_r}$

To test the hypothesis $\mathrm{RP}=\mathrm{RP_r}$, the Relethford (1992) method was applied to calculate the statistical z:

$z=(\mathrm{RP}-\mathrm{RP_r})/\mathrm{SE}(\mathrm{RP_r})$.

In this formula $\mathrm{SE}(\mathrm{RP_r})$ is the standard error of the random component, derived from Chakraborty (1985).

Results and Discussion

Choice of mate: Spanish–Portuguese origin

Table 1 compares the period 'before' with the period 'after' the change of domain from Portugal to Spain in 1801. The test of homogeneity of frequencies in this table gave a χ^2 value of 235.91 ($p<0.001$), which indicates the existence of significant differences in the distribution of marriages regarding birthplace. These differences are

Table 1. Number and percentage of marriages in Olivenza 'before' (1750–1800) the change of sovereignty from Portugal to Spain and 'after' this change (1801–1850)

	Before	After
Olivenza–Olivenza	696 (42.65)	812 (48.36)
Portugal–Olivenza	665 (40.75)	404 (24.06)
Spain–Olivenza	67 (4.11)	181 (10.78)
Both Spanish	10 (0.61)	104 (6.19)
Both Portuguese	158 (9.68)	96 (5.72)
Spanish–Portuguese	36 (2.21)	82 (4.88)

explained by the reduction of mixed marriages formed by Portuguese and Olivenza natives.

Table 2 shows data for ten consecutive periods. The low number of marriages in 1750–1770 and 1841–1850 is due to the lack of data in one of the two parishes of Olivenza (Santa Marìa Magdalena). The reduction of marriages occurring in 1831–1840 is explained by an outbreak of cholera widely affecting Spain, with maximum virulence in the summers of 1833 to 1834 (Nadal, 1976).

In this table it is observed that the percentage of endogamous marriages according to birthplace (both spouses born in Olivenza) reached the maximum value (53.69%) following the change of sovereignty. In this period, immigration into Olivenza would have been limited due to the political instability at that time, thus resulting in increased endogamy. Although from 1791–1800 to 1801–1810 mixed Portugal–Olivenza marriages had reduced (26.11% in 1801–1810), they remained more common than Spain–Olivenza mixed marriages. Before the change of domain, mixed Spanish–Olivenza marriages had begun to increase slightly (1781–1790=3.46; 1791–1800=5.15), consolidating in the last periods studied (since 1831). By contrast, a drastic variation affected couples composed of two Spaniards (increase) while the percentage of those formed by two Portuguese remained oscillating throughout the whole period analysed. In 1841–1850 percentages in each class of mixed marriages (Portugal–Olivenza, Spain–Olivenza) became closer (25.19–15.27%) but mates from Portugal were still more frequent than those from Spain. This suggests that, although less intense, after 1801 business and social relations between Portugal and Olivenza continued. Approximately the same number of Spanish males and females contributed to mixed marriages in Olivenza, while Portuguese males outnumbered females (Fuster *et al.*, 2007).

Regarding homogeneity among the ten periods displayed in Table 2, no significant differences were found for the first four (χ^2=19.30; p=0.200). If the period 1791–1800 is added, the statistics become χ^2=41.55 (p=0.003). According to this result, in this later period the mating pattern had already begun to change, the greater contribution to the χ^2 value corresponding to the categories Olivenza–Olivenza and Portugal–Olivenza. The first two periods after the change of domain (1801–1810 and 1811–1829) are homogeneous (χ^2=8.11, p=0.150). The same applies to the last two periods (1831–40 and 1841–50; χ^2=2.57, p=0.766). The period 1821–30, however,

Table 2. Number and types of marriages celebrated in Olivenza 1750–1850, according to the birthplace of mates, diversity of surnames and Shannon (*H*) and *A* indexes[a] by period

Variable	1750–60	1761–70	1771–80	1781–90	1791–1800	1801–10	1811–20	1821–30	1831–40	1841–50
Number of marriages	281	263	474	544	472	476	440	401	330	273
Type of marriage %										
Olivenza–Olivenza	42.40	47.37	38.12	38.80	49.48	53.69	50.00	43.82	46.21	46.18
Portugal–Olivenza	41.94	42.63	46.29	43.19	30.67	26.11	21.96	23.88	23.10	25.19
Spain–Olivenza	5.99	3.16	3.22	3.46	5.15	7.39	8.73	9.83	15.52	15.27
Both Spanish	0.46	0.00	0.50	0.69	1.03	5.42	6.88	5.90	5.78	7.25
Both Portuguese	6.45	5.26	9.90	12.24	10.57	3.94	6.61	10.39	3.97	2.67
Spanish–Portuguese	2.76	1.58	1.98	1.62	3.09	3.45	5.82	6.18	5.42	3.44
Mixed marriages (Pt–Oliv+Sp–Oliv)	47.93	45.79	49.51	46.65	35.82	33.5	30.69	33.71	38.62	40.46
Variability of surnames										
Total surnames	255	225	417	468	392	440	396	392	551	484
Surnames counted once	106	111	158	188	177	210	196	224	214	188
Shannon index (*H*)[b]										
Total	3.91	4.08	4.23	4.55	4.50	4.77	4.73	4.97	4.74	4.64
Spain	2.41	2.16	2.24	2.51	2.98	3.37	3.66	4.07	4.07	4.10
Olivenza	3.33	3.29	3.59	3.63	3.63	3.98	3.67	3.83	4.26	4.12
Portugal	3.23	3.42	3.41	3.63	3.49	3.42	3.35	3.60	3.41	3.63
A index	11.60	14.20	9.50	11.10	10.70	12.60	12.00	15.40	27.40	24.00

[a]Rodriguez-Larrade & Barrai (1998).

[b]Shannon indexes of individuals born in Spain, Olivenza and Portugal.

was not homogeneous regarding the two preceding decades (χ^2=22.20, p=0.014) or in comparison with the two following decades (1831 to 1850), with χ^2=26.15 (p=0.003).

These results confirm a new marriage pattern at the time of the change of domain. The number of Olivenza–Olivenza couples had begun to increase before the border change, while Portugal–Olivenza marriages had started to reduce.

Thus, a period of instability around the change of sovereignty (1791–1810) took place leading to increased endogamy and lower Portuguese immigration into Olivenza.

Variability of surnames and nationality

The initial difficulty of identifying surnames transmitted from one generation to the next during the period of Portuguese sovereignty (1750–1800) was overcome by comparing pairs of surnames of grooms and brides with those of their fathers. Following the procedure described in the Methods, the first surname of the groom and the first surname of the bride's father were used. Based on these surnames, their diversity was calculated for each consecutive period, as shown in Table 2.

Surname diversity increased in Olivenza, with the Shannon index increasing from 3.91 in the first period analysed to 4.64 in the last, becoming maximum in 1821–1830. The above corresponds to a larger Shannon index mainly for individuals of Spanish origin, for whom the index varied in the same period (1821–1830) from 3.66 a 4.07 (Table 2). This index, however, experienced slight variation among Portuguese newcomers. The Shannon index variation is concordant with a larger number of Spaniards marrying in Olivenza. Without making a distinction between Spanish or Portuguese origin, total mixed marriages remained rather uniform over time. But, from the period prior to the change of border, Spain–Olivenza matings became more numerous, resulting in the appearance of new surnames. The five most frequent surnames experienced a marked reduction following the change of domain, from 40% in 1750–1760 to 21% in 1841–1850. Concerning the frequency of surnames present only once, expressed by the *A* index (Rodriguez-Larralde & Barrai, 1998), high values occurred in the last two periods, but its increase began after the change of frontier (Table 2, bottom) as a consequence of immigration taking Spanish surnames into Olivenza.

Repeated-pairs of surnames

The method of repeated-pairs was based on 2351 pairs of surnames accounting for 1717 different combinations, 84% of which appeared only once. There are only slight variations concerning the temporal change. However, an increase of pairs of surnames counted once is noticeable during the periods under Spanish sovereignty (Table 3).

Table 3 shows the RP coefficients by period. The maximum excess of RP in comparison to RP_r was during the decade prior to the change of sovereignty, and continued elevated in the period 1811–1820. The entrance of more Spanish surnames coinciding with the increase of the number of Spain–Olivenza marriages in 1791–1800 and the noticeable elevation in the number of marriages between Spaniards (1801–1810) (Table 2) could explain the elevation of RP in the period 1791–1800 and

Table 3. Coefficients of repeated-pairs of surnames in each period, Olivenza 1750–1850

Variable	1750–60	1761–70	1771–80	1781–90	1791–1800	1801–10	1811–20	1821–30	1831–40	1841–50
Pairs of surnames	158	148	284	277	229	280	253	266	239	217
Pairs of surnames counted once (%)	78.48	84.46	77.11	80.14	82.97	87.86	83.79	88.35	94.98	94.01
Repeated-pairs of surnames (%)	27.42	18.40	29.68	24.77	20.53	13.82	19.34	13.19	5.29	6.37
RP	2.58	1.20	1.42	0.76	0.92	0.51	1.04	0.57	0.21	0.34
RP_r	3.44	1.51	1.37	0.64	0.70	0.47	0.74	0.50	0.22	0.28
$(RP-RP_r)/RP_r$ (%)	−25.08	−20.74	3.20	19.27	30.97	8.57	39.97	14.43	−2.49	20.25
z test for H_0: $RP=RP_r$	−1.01	−0.71	0.22	1.26	1.34	0.55	2.42*	0.98	−0.14	1.14

*$p<0.05$.

RP=observed; RP_r=expected; values multiplied by 10^3.

its later reduction in 1801–1810, when there was a greater frequency of Olivenza–Olivenza matings. This fact is attributed to a certain tendency to local endogamy in the years of political instability after the change of domain. However, according to the z statistics, differences are significant only between 1811 and 1820 ($p<0.05$), reflecting a certain increase of marriages between individuals of the same origin and the reduction of mixed marriages (Table 2).

An excess of RP over RP_r shows a diminution of genetic variability because of population subdivision due to the admixture of lineages by preferential matings (Wahlund effect). Since a significant difference between RP and RP_r was detected only in a short period of time (1811–1820), the excess of RP could not indicate such an effect in Olivenza over an extended time period. This difference is understood in the context of preferential matings affecting also the type of marriage according to birthplace. After the change of sovereignty, there was a tendency towards marriage among individuals of the same nationality or of common origin in the preceding generations. The observed (RP) and expected (RP_r) values became close in the late periods, which could be an indication of the disappearance of limitations regarding the choice of mate due to an increased Spanish immigration beginning in 1831 (Table 2).

When these results are compared with those obtained in other European regions, RP in Olivenza is greater than reported by Vernay (2000) in France, Manfredini (2003) in Italy or by Esparza *et al.* (2006) in Spain. These populations, for time periods close to those here analysed, had a smaller number of inhabitants than Olivenza, and probably less social stratification and fewer preferential marriages. In the Italian Tyrol, subdivision was detected by RP only in localities where the population size was large enough to make possible marital endogamy (Riegler *et al.*, 2007). The situation differs in Olivenza, where military presence may have encouraged marriages between members of families of a similar military rank, thus limiting mixed Spanish and Portuguese marriages after the change of border.

Lasker *et al.* (1986) and Relethford (1992) demonstrated a clear relationship between RP and population size. However, an equivalent analysis was no possible in Olivenza due to the lack of information on the census size temporal variation.

The fact that Olivenza was a garrison may have resulted in a certain social stratification based on military rank. The observed RP may exceed the expected because of social stratification. However, although this factor would explain the high values of RP in comparison with other populations, it cannot explain the observed $RP–RP_r$ differences between periods in Olivenza (Table 3, bottom), because this town always maintained a garrison previous to and after the change of sovereignty. If the excess of RP had been created by social class only, the excess of RP observed throughout all the periods would have remained stable; therefore, a more likely cause is preferential mating between individuals of the same place of birth.

Using surnames as evidence for any limitation to the gene flow has been proved by several authors. These limitations include diverse factors – geographical, social, religious, linguistic and political. According to Koervelyessy *et al.* (1992) and Manni *et al.* (2004), the religious factor is important as revealed by RP as an indicator of population subdivision. But ethnicity was declared a secondary factor in other studies in comparison to geography (Vienna & Biondi, 2001; Biondi *et al.*, 2005; Tagarelli *et al.*, 2007). The combined effect of political and geographic barriers was studied by

Eizaguirre (1994) at the northern Portugal–Spain border defined by the Miño River. This author was aware of the difficulties in establishing whether one or two breeding groups (Spanish–Portuguese) could be recognized. Despite this lack of definition, the Miño River was considered a barrier to gene flow in combination with the political border.

Conclusions

In Olivenza, in the period before the change of sovereignty (1791–1800), the number of mates born in Portugal reduced, whereas those born in Spain increased. This variation was initially due to couples consisting of Spaniards, while mixed marriages including one member born in Olivenza modified more gradually: mixed marriages with Spaniards increased while those with Portuguese decreased. Despite these modifications of the mating pattern, in 1841–1850 the Spanish–Olivenza marriages still remained fewer than Portuguese–Olivenza marriages. Although local endogamy increased slightly in the period 1801–1810 to 53.69%, perhaps due to the political instability after the change of border, resulting in a certain amount of isolation, there was not noticeable variation in the following periods. The genetic flow derived from the border modification was initially balanced by a population subdivision, possibly motivated by preferential mating between individuals of the same lineage or of the same national origin.

In a long-term perspective, the political barrier resulting in a change of sovereignty modified the mating pattern of the population. Permanent effects of the immigrant nationalities on the genetic structure of the native population could have been diffused because of a gradual mix following the change of sovereignty.

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