Cultural Inheritance and the European Marriage Pattern

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Abstract

Eric Turkheimer famously stated as a Law "All human behavioral traits are heritable." But this poses a puzzle for pre-industrial demographic systems, such as the European Marriage Pattern, where individuals made behavioral choices that limited fertility. Why were these behaviors not replaced over time with those that generated higher fertility? Some have argued the solution to this puzzle is that limited fertility in the first generation was actually maximal fertility in subsequent generations. But we show that there was no fertility penalty to future generations from higher fertility in the initial generation in both England and Quebec. Here we argue instead that the European Marriage Pattern survived for more than 500 years because, for pre-industrial fertility behavior, Turkheimer's Law does not hold. Even though at the social level fertility limiting behaviors transmitted strongly, there was scant familial inheritance of fertility behaviors. So fertility enhancing deviations did not get transmitted across generations, and the European Marriage Pattern could persist indefinitely. In the paper we show evidence of horizontal as opposed to vertical transmission of fertility behaviors.

1 Introduction

The European Marriage Pattern (EMP) had four main feature: late age of first marriage for both men and women, a substantial fraction of men and women never marrying, unrestricted fertility within marriage, and sexual abstinence before engaging to marry. Since the pattern was first documented by John Hajnal (1965, 1982, 1983) there has been debate about when this fertility limiting behavior first emerged.[1]. But in England and France it certainly persisted for at least 350 years, and potentially for more than 500 years. The EMP has been proposed as a — and sometimes the — key mechanism for the

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[1]See Hallam, (1985), De Moor and Van Zanden (2010), Voigtländer and Voth (2013), Bennett (2019), and Edwards and Oglivie (2021)

rise of Europe economically 1400-1800. By limiting fertility and delaying marriage for women, the EMP has been attributed as fostering a society with relatively greater gender equality and higher levels of education (De Moor and Van Zanden (2010), Foreman-Peck (2011), Foreman-Peck and Zhou (2018), Carmichael et al. (2019)).

However, one notable feature of the EMP is the importance of individual decisions by couples. The average age of first marriage by women may have been 25 under the EMP, for example, but some women married at 14 and some at 40. If deviations from the norm in terms of age of marriage and propensity to marry resulted in more surviving offspring, and these behavioral deviations were inherited, then a puzzle arises about how such a marriage pattern could be sustained more than 500 years? Why don't the deviations towards higher fertility end up taking over the whole population.[2]

If individual behaviors varied within the EMP, then a puzzle arises about how the pattern sustained itself for potentially more than 500 years. If deviation from the pattern resulted in more surviving offspring, and these deviations were inherited, the pattern would collapse in a few generations. To take a modern example, the Haredi (ultra-orthodox) community in Israel has a much higher fertility than the rest of the population. As a result their share of the population has swollen from 1% of the Jewish population in Israel 1948 to 21% by 2020. Even though their fertility has begun to decline it is projected that by 2059 the ultra-orthodox will be a full 35% of the Jewish population (Cahaner and Malach, 2019).[3]

One possible answer that we explore here is that in practice the norm of the European Marriage Pattern was in fact the reproductively most successful pattern. Galor and Klemp (2019) assert for data from Quebec pre-1800 that this was indeed the case. They argue there was an interior optimum of fertility in terms of surviving offspring in following generations. If this was the case, we'd expect reduced fertility through delayal of or abstinence from marriage to provide some survival advantage to one's descendants or relatives. We shall see however, that there is no such evidence of survival advantage from following the norms of the European Marriage Pattern, either in Quebec 1600-1848, or in England 1650-1849. Restraint on fertility was never optimal in terms of ultimate reproductive success.

In both England and Quebec families did not practice fertility control within marriage before 1880 (Clark, Cummins, and Curtis 2020). Yet the average fecundity of couples, as measured by the average interval between births, varied widely across marriages, and was typically two or more years. The re-

[2] In contrast in East Asia where fertility was limited by low fertility rates, there was much less variation among women in the age of first marriage, and almost no variation in celibacy rates.

[3] Similarly the Old Order Amish in North America, who do not practice birth control and have an average of 5 children per couple, are doubling their population each 20 years primarily through internal growth (even though 15% of each generation leave the religion). (Amish Population Profile, 2020). In contrast the Shakers, founded in 1747, who practiced celibacy, died out once they could no longer attract new members.

productive biology and/or coital frequency of couples varied significantly. If lower birth intervals were associated with more surviving children, then again across hundreds of years there should be selective pressures towards lower birth intervals. Again we find that there is no such interior optimum. Using the first birth interval as a metric of fecundity, the shorter the interval between marriage and first birth, the greater is netfertility.[4]

What we show in this paper is that the European Marriage Pattern survived because fertility increasing behaviors — early marriage, a high propensity to marry, and short birth intervals — were not significantly inherited at the familial level. Indeed there is an ecological prediction that if an environment is constant, as can be argued for European society 1350-1800, any trait correlated with fitness should have a heritability of zero, or else not vary substantially across the population.[5]

This lack of individual heritability has two potential sources. The first is that reproductive behaviors were indeed homogeneous across families. The variations in European Marriage Pattern behaviors across individuals were not the product of different reproductive strategies, but instead random shocks within a common behavioral approach to marriage and reproduction. Children were indeed strongly inheriting parent behaviors, except what they were inheriting was a common approach to marriage and reproduction, and not the actual realizations. We show however, by considering siblings, that reproductive behavior did actually vary across families. Siblings were indeed correlated in fertility outcomes. The lack of correlation between parents and children in reproductive behaviors thus does imply an absence of heritability for these traits.

The second potential source of the lack of individual heritability, despite the persistence of the EMP across many generations, is that children acquired a cultural disposition towards the European Marriage Pattern from society as a whole, not their own parents. The data does show that children within a family correlated more with their siblings on fertility behavior than they did with their parents. These findings thus leave us with a puzzle: what explains this cultural transmission from generation to generation?

[4]This is true even when we censor the first birth interval to no less than 10 months to rule out cases of premarital intercourse.

[5]This is an interpretation of Fisher's Fundamental Theorem. See Murphy and Knudsen, 2002, p. 236 and Frank and Slatkin, 1992.

2 Description of the databases

2.1 Families of England

The Families of England is a genealogical database created by identifying all known holders of a set of rarer surnames in England 1650-2021. The period of unrestricted fertility within marriage in England and Wales extends for men and women in this database born 1650-1849 (See Clark, Cummins and Curtis, 2020). In this period there are 90,543 people in the database, with 45,716 with age at first marriage, 30,351 with complete records of child births, and a total of 98,437 children born.

The outline statistics for age at marriage, percent celibate, and first birth interval in table 1 show clearly the European Marriage Pattern. Indeed for this database the marriage pattern is remarkably stable all the way from those born 1650 to 1849.[6] Table 1 shows the marriage parameters for anyone reaching age 21 before death. We can also calculate these marriage parameters just for those who reach age 40. This has little effect on the proportion never marrying, but does raise the average ages of marriage by about 1 year. One advantage of the FOE database is that it follows also people who migrate from England and Wales, for at least one generation.

The nature of the Families of England database is that it follows fertility in all males, but does not capture all marriages for females. Thus while the male celibacy rate should be accurate, celibacy for females is overestimated because of missing marriages.

Table 1: Outline Statistics for FOE, Births 1650–1849

Period	Births	M, age at first marriage.	F, age at first marriage.	M, cel. 40+	F, cel. 40+	FBI
1650-1699	3,421	27.3	24	14	10	1.97
1700-1749	6,576	27.7	24.6	13	11	2.90
1750-1799	17,812	27.8	24.8	13	17	3.39
1800-1849	54,239	27.7	25	13	18	3.51

Note: Definite celibacy is defined as dying at age 40 or greater without having a spouse recorded. FBI is the interval between marriage and first birth in years.

[6] In this respect the data does not show the decline in marriage ages, and increase in fraction marrying reported by Wrigley et al., 1997, for England 1740–1837.

Table 2: Outline Statistics for IMPQ, Births 1600–1828

Period	Births	M, age at first marriage.	F, age at first marriage.	M, cel. 40+	F, cel. 40+	FBI
1600-1649	214	26.9	15.5	15	8	2.85
1600-1699	15,194	27.4	21.2	7	8	1.50
1700-1749	73,077	27	23.1	6	6	1.34
1750-1799	246,663	26.4	23.4	4	4	1.38
1800-1828	291,164	24.7	22	1	1	1.40

Note: Definite celibacy is defined as dying at age 40 or greater without having a spouse recorded. Note that the seeming decline in definite celibacy starting around 1750 is likely due to the lack of observed deaths after 1849; only individuals who died relatively young are observed as celibate. FBI is the interval between marriage and first birth in years.

2.2 IMPQ

The IMPQ is a database of linked vital records from Quebec of all births by family 1600-1849, as well as all intergenerational links. After 1849 the database records only marriages, but not births or deaths. To cover all children reaching age 21, we only consider births up to 1828. This database has the advantage of following the entire Quebec population. It does not follow people who leave Quebec to live elsewhere in Canada or abroad. But for those born 1828 or before, this would be a very small share of the population.

Table 2 shows the same summary statistics for marriages in this population also. This also shows clearly a version of the European Marriage Pattern after 1650, though with lower rates of celibacy than for England. In the first period the age of first marriage of women was very low and outside the European Marriage Pattern norms. But this was a period where there was a significant shortage of women in the colony, with brides being imported from France specifically with marriage as the plan.

In both populations we see that the European Marriage Pattern is stable across hundreds of years, with no decline in ages of first birth, in celibacy rates, or in the first birth interval.

3 The Intergenerational Stability of the EMP

3.1 Age at marriage

Figure 1 shows the lifetime fertility of women born in England 1650–1849, measured as numbers of children attaining age 21, as a function of their age at first marriage (by equally-sized bins of age at first marriage). Women marrying young have the highest net fertility.

A test that there are no second generational impacts of the age of women at first marriage in the first generation is provided by looking at the numbers of grandchildren surviving to age 21 per married child by the age of grandmother at first marriage. This is also shown in figure **??**. In terms of numbers of adult grandchildren, younger age at first marriage still produced the most children, but their children do not appear substantially different.

Figure 2 shows the same data as for figure 1, but this time for women born in Quebec 1600–1788.

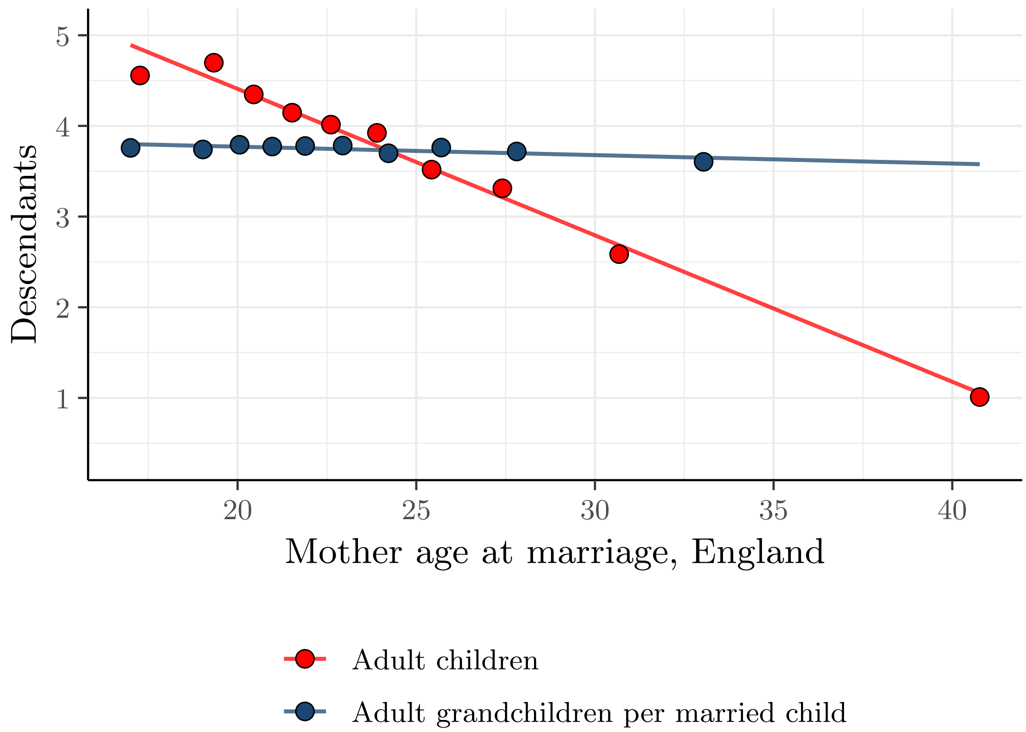

Figure 1: Age of First Marriage and Descendants, England

Note: Data averaged over 10 equal sized bins of marriage age. Best fit line shown. Sample includes all women born in England and Wales 1650-1849 with complete fertility observed. The number of grandchildren per married child only includes married children born in England and Wales 1650-1849 with complete fertility observed and their offspring.

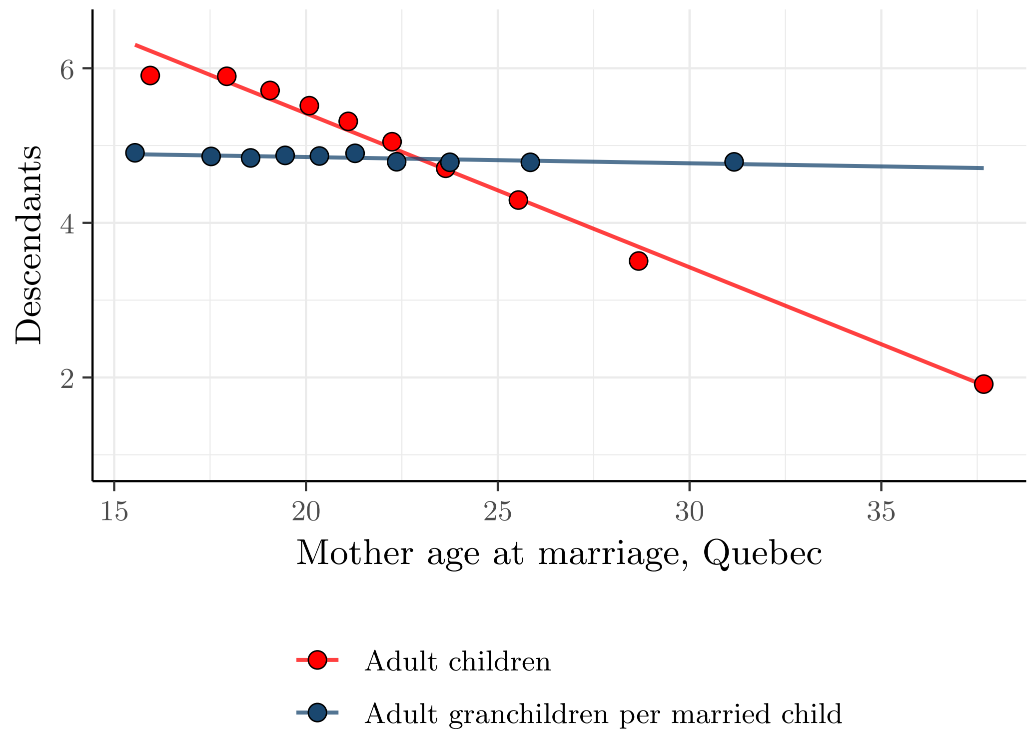

Figure 2: Age of First Marriage and Descendants, Quebec

Note: Data averaged over 10 equal sized bins of marriage age. Best fit line shown. Sample includes all women born in Quebec 1600-1788 (so complete fertility is observed) and all children born in Quebec 1600-1849. The number of grandchildren per married child only includes married children born in 1600-1788 (so complete fertility is observed) and their offspring.

For both England and Quebec the grandchild numbers show that we cannot, as Galor and Klemp (2019) attempts to do for Quebec, explain the persistence of the European Marriage Pattern across many generations through positing that reduced fertility optimizes numbers of survivors across multiple generations. In terms of survival there is no sign of any quality-quantity trade-off in the first generation. The younger grandmothers have more surviving grandchildren in both societies.

The data in figures **??** and 2 thus reinforce the puzzle of the persistence, across multiple generations, of the European Marriage Pattern. Deviations from the pattern in the form of younger marriage ages by women are associated even in the second generation with greater numbers of surviving grandchildren. In England 72% of the second generation of wives had a mother who was less than 25 at first marriage, even though 25 was the mean age at first marriage for women born in England 1650-1849 (table 1). Then 74% of next generation of children in England surviving to age 21 had a grandmother less than 25 at first marriage. If marital behaviors were significantly inherited then we would see over time a decline in the average age at marriage in both England and Quebec.

However, already in figures **??** and 2 we see sign of why the European Marriage Pattern could maintain itself unchanged over time. For the 74% of grandchildren in England having a grandmother aged less than 25 years compared to 72% of children implies that there was little inheritance of age at first marriage. Otherwise the differential in numbers of surviving offspring would have widened further in favor of younger grandmothers by the time of the third generation.

Table 3 confirms that there was little inheritance of female age at first marriage for daughters or daughters in law in both England and Quebec. The intergenerational correlation of age at first marriage was only in the range 0.05–0.09. This meant that the average daughter or daughter in law in England, for example, married for the first time 3 years later than her mother or mother in law. Daughters and daughters in law conformed more closely to the norms of the European Marriage Pattern than did their mothers or mothers in law. They moved closer to average social practice in terms of age of marriage, and away from their parents' example. Thus the daughter of an English woman who marriage first at age 15 would typically marry first at age 24, just one year below the social average. We discuss below what would explain this pattern of inheritance.

Table 3: The Intergenerational Correlation of Female Age at First Marriage

	Mother's age at first marriage			
	England	England	Quebec	Quebec
Daughter's age at first marriage	0.091***		0.061***	
	(0.009)		(0.003)	
Daughter in law's age at first marriage		0.053***		0.050***
		(0.008)		(0.003)
N	12,142	14,824	153,396	132,154

Note: England sample includes all parents and children born in England and Wales 1650-1849 who have complete fertility observed. Quebec sample includes all parents and children born in Quebec 1600-1788 (so complete fertility is observed.) Correlations computed by first standardizing each variable by dividing by one standard deviation then by simple linear regression. Standard errors in parentheses. *p<0.10; **p<0.05; ***p<0.01.

3.2 Celibacy

A second feature of the European Marriage Pattern was the significant fraction of women and men remaining celibate throughout their lives. This is illustrated in both England and Quebec in tables 1 and 2. Since the children of each generation come exclusively from those who were not celibate, again a puzzle arises as to how this cultural pattern persisted across many generations?

One solution would be that celibate and childless individuals aid the reproductive success of their married siblings. Some celibacy, at the kin level, could be a behavior which maximizes reproductive success. Therefore, in figures 3 and 4 below, we plot the number of children (surviving to 21+) per sibling in each family in England and Quebec, and the number of children (surviving to 21+) per married child, as a function of the fraction of siblings celibate at age 40.

As shown in these figures, the greater the fraction of siblings who are celibate, the lower is overall reproductive success per child. The greater the fraction celibate the lower the numbers of adult children per sibling in both England and Quebec. There is no interior optimum in terms of celibacy for reproductive success. Further there is no sign that celibate siblings had any positive effect on the reproductive success of their married siblings. The figures also show as a function of the share of siblings celibate, that a higher fraction celibate was not associated with a greater number of surviving children per married sibling. In England celibate siblings seem to have had no effect on their married counterparts. In Quebec the figure suggests a negative relationship between the fraction of siblings celibate and the reproductive success of married siblings.[7]

If the tendency to marry was significantly inherited then we should observe over time a decline in the fraction unmarried in both these societies. However, again the tendency to marry was weakly inherited within families across generations. Table 4 shows the intergenerational correlation in celibacy rates. It looks at the correlation of a mother's children's celibacy rates with each child's children's celibacy rate, divided into female and male children.

[7] This is not necessarily a causal relationships. It is likely that the tendency for siblings to be celibate and other factors that reduce fertility, such as age at first marriage, were correlated.

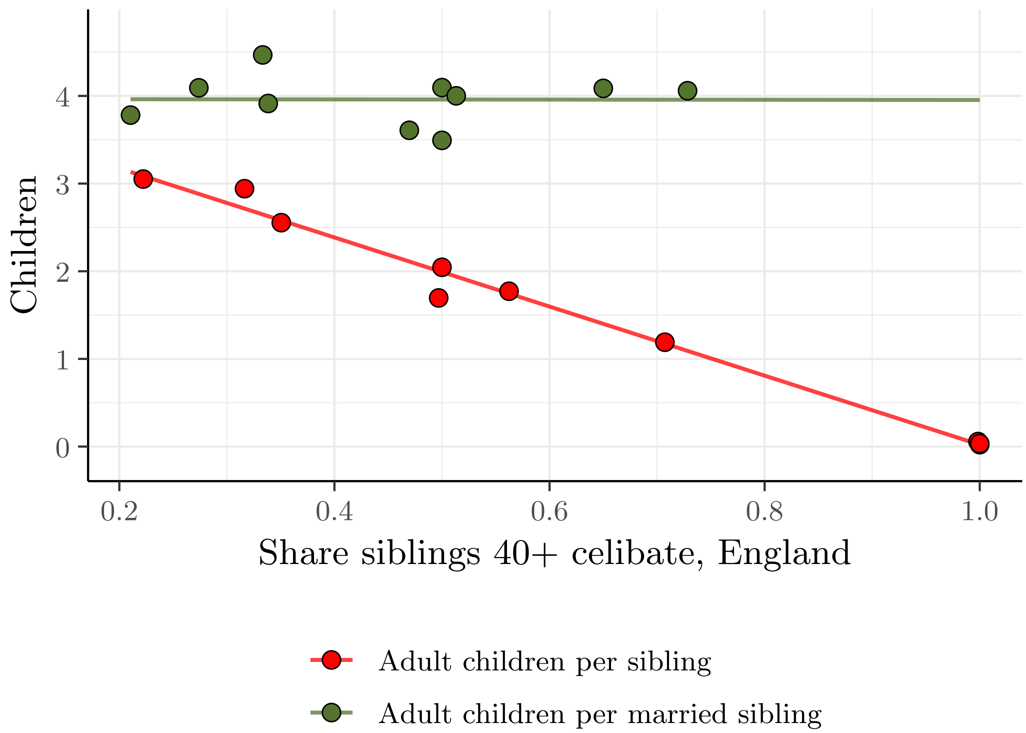

Figure 3: First Birth Interval and Reproductive Success, England

Note: Data averaged over 10 equal sized bins of sibship celibacy rate. Best fit line shown. Sample restricted to all siblings born in England and Wales 1650-1849 with complete fertility observed, whose mother's complete fertility is observed. As celibacy was somewhat unusual, the sample is further restricted to families where at least one sibling was celibate in order to more clearly show the relationship between celibate siblings and fertility.

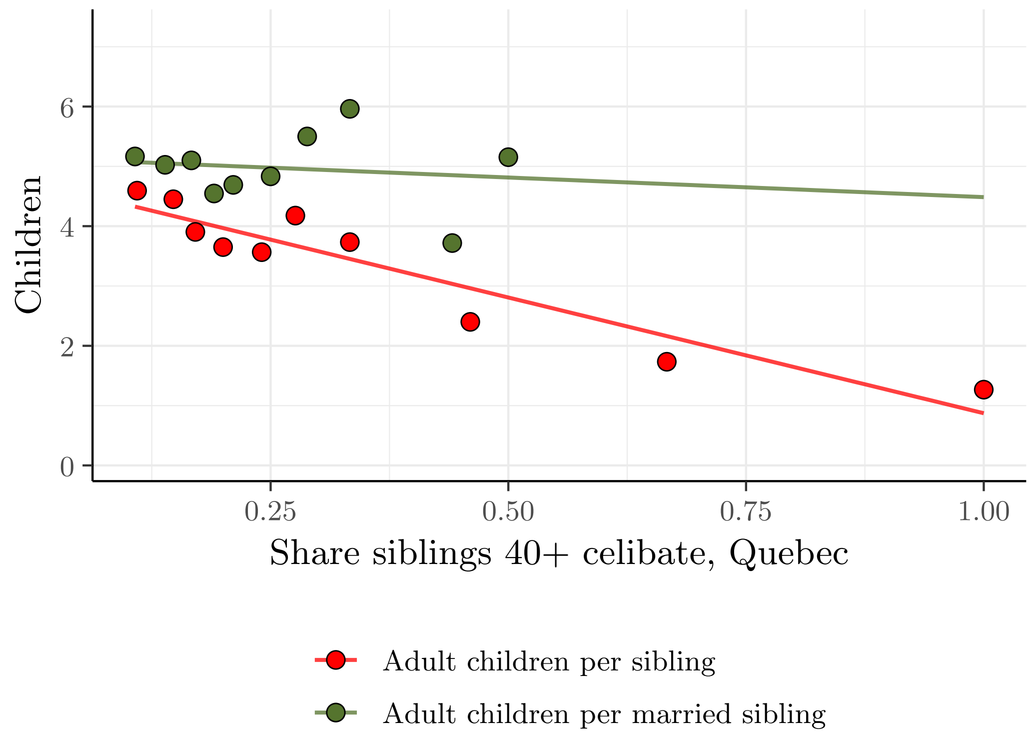

Figure 4: First Birth Interval and Reproductive Success, Quebec

Note: Data averaged over 10 equal sized bins of sibship celibacy rate. Best fit line shown. Sample restricted to all siblings born in Quebec 1650-1788 (so complete fertility is observed) whose mother's complete fertility is observed, and all children born in Quebec 1600-1849. As celibacy was somewhat unusual, the sample is further restricted to families where at least one sibling was celibate in order to more clearly show the relationship between celibate siblings and fertility.

Table 4: The Intergenerational Correlation of Tendency Towards Celibacy

	Mothers's share children celibate			
	England	England	Quebec	Quebec
Daughter's share children celibate	0.059 (0.041)		0.052*** (0.005)	
Son's share children celibate		0.097*** (0.014)		0.037*** (0.005)
N	594	4,929	45,427	41,227

Note: England sample includes all parents and children born in England and Wales 1650-1849 who have complete fertility observed and survived to at least age 40. Quebec sample includes all parents and children born in Quebec 1600-1788 (so complete fertility is observed) who survived to at least age 40. Correlations computed by first standardizing each variable by dividing by one standard deviation then by simple linear regression. Standard errors in parentheses. *p<0.10; **p<0.05; ***p<0.01.

As can be seen, the correlation is low, only in the order of 0.03-0.10. This means that though families with higher marriage rates produce more grandchildren, these grandchildren inherit very little of the previous generations tendency to higher marriage rates. If the average marriage rate was 0.90, then a family with universal marriage among siblings would have an expected marriage rate for the next generation of 0.905. There was very weak selective pressure on marriage rates, and thus again the European Marriage Pattern could survive.

Indeed remarkably while all children came from parents who had not chosen celibacy, their children on average chose celibacy at rates similar to the general population, little influenced by the family background with regards to celibacy.

3.3 Fecundity

There were significant differences across couples in their fecundity within marriage. Fecundity is often measured in pre-industrial populations using the first birth interval — the time between marriage and the first birth (Klemp and Weisdorf (2018), Galor and Klemp (2019)). But this is problematic for populations with the European Marriage Pattern, since sex before marriage was common, so that many births occur before 38 weeks of the marriage. In the Families of England database, for example, 22% of first births are within the first 38 weeks of marriage. The first birth interval is then sometime measured starting at 38 weeks to exclude such premarital conceptions. But that means that less fecund couples who engaged in premarital sex will be included among the genuinely fecund who engaged in sex only after marriage. Here we look at net fertility as a function of the first birth interval, where we also include the interval 0-38 weeks as reflecting through premarital sex another form of reproductive behavior.

Figure 5 shows for England total births per woman, as well as children surviving to age 21, for first birth intervals between 0 and 5 years. Figure 6 shows the same information for Quebec.

In terms of reproductive success optimal fecundity was the shortest birth interval. Indeed, not only do mothers with the shortest birth interval have the most births, they also have the largest fraction of children surviving to age 21. There is no sign that less fecund parents have better survival rates for their offspring, so that there is a quantity-quality trade-off in terms of net fertility. Once again there will be a selective pressure towards the children of more fecund women in the next generation

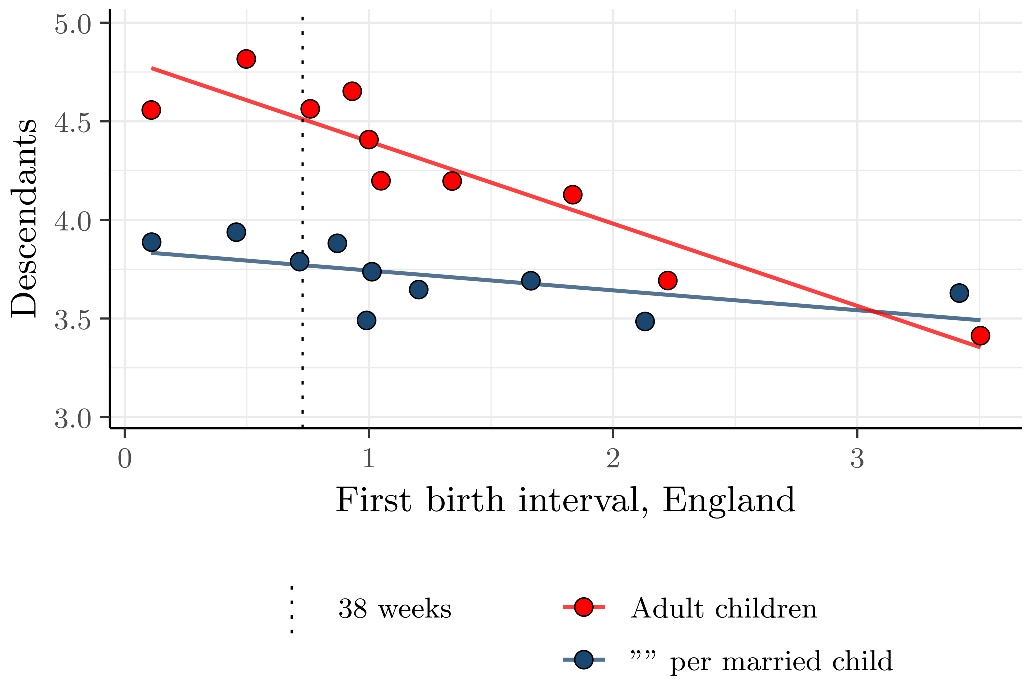

Figure 5: First Birth Interval and Reproductive Success, England

Note: Data averaged over 10 equal sized bins of first birth interval. Best fit line shown. Dashed line shows a first birth interval of 38 weeks. Sample includes all women born in England and Wales 1650-1849 with complete fertility observed and a first birth interval of 0-5 years. The number of grandchildren per married child only includes married children born in England and Wales 1650-1849 with complete fertility observed and their offspring.

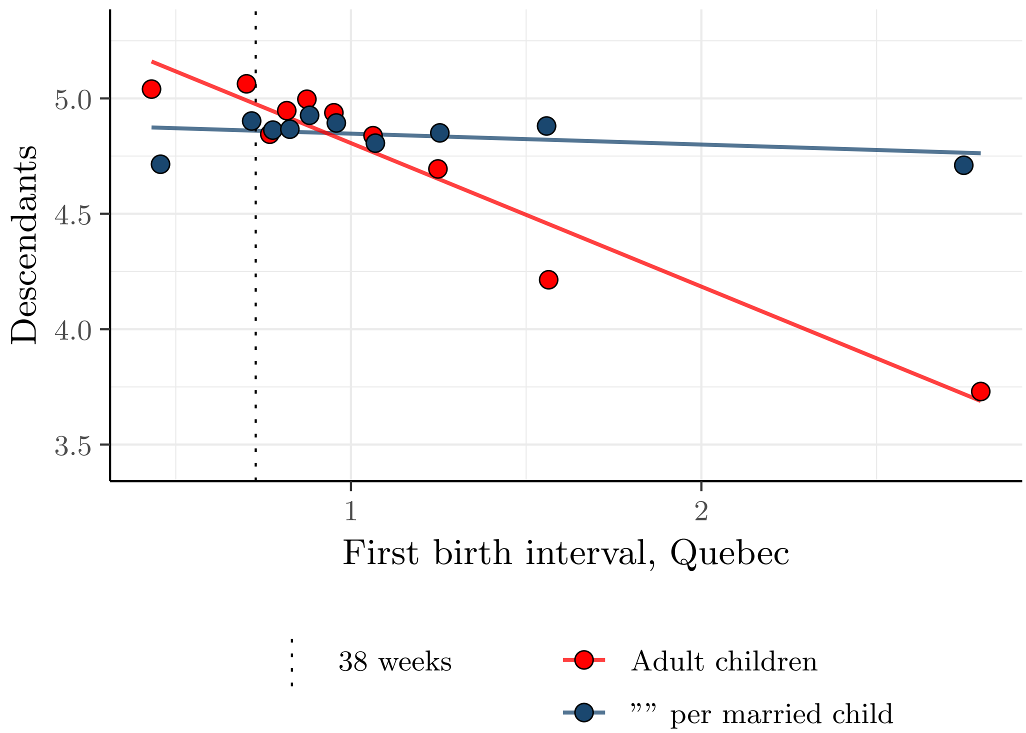

Figure 6: First Birth Interval and Reproductive Success, Quebec

Note: Data averaged over 10 equal sized bins of first birth interval. Best fit line shown. Dashed line shows a first birth interval of 38 weeks. Sample includes all women born in Quebec 1650-1788 (so complete fertility is observed) with a first birth interval of 0-5 years and all children born in Quebec 1600-1849. The number of grandchildren per married child only includes married children born in Quebec 1650-1788 (so complete fertility is observed) and their offspring.

Table 5: The Intergenerational Correlation of First Birth Interval

	Mothers's adjusted FBI			
	England	England	Quebec	Quebec
Daughter's adjusted FBI	-0.009		0.028***	
	(0.037)		(0.006)	
Daughter in law's adjusted FBI		0.020		0.030***
		(0.015)		(0.007)
N	727	4,187	29,261	22,167

Note: England sample includes all parents and children born in England and Wales 1650-1849 who have complete fertility observed. Quebec sample includes all parents and children born in Quebec 1600-1788 (so complete fertility is observed). First birth interval adjusted by partialling out age at first marriage fixed effects for the mothers, daughters, and daughters in law. Correlations computed by first standardizing each variable by dividing by one standard deviation then by simple linear regression. Standard errors in parentheses. *p<0.10; **p<0.05; ***p<0.01.

Table 5 shows the intergenerational correlations of first birth intervals. Since there is a connection between mother's age and fecundity and mother's age is weakly heritable, we first age adjust the first birth interval to correspond to women marrying at age 24. These correlations are in the range 0.00-0.03

Again the correlations, though often statistically significant, are extremely low. Interestingly they are also very similar between England and Quebec. There was little selective pressure towards either behaviors or biology that generated shorter birth intervals.

Again, note that these analyses include couples who gave birth before 38 weeks. This include couples who engaged in premarital sex as well as those who gave birth to premature children. Interestingly there is indication in both figures that such early births were associated with greater descendants, implying that breaking the strong social norms against premarital sex increased the number of one's descendants. However, this such behavior was so weakly inherited that there was no demographic pressure to erode the norm.

4 Heritability of Net Fertility

Here we consider the heritability of net fertility, defined as the numbers of children living to age 21 or greater, for families in the period before fertility control within marriage. In these years because of a great range across individuals in the numbers of adult children they produced, a large fraction of the surviving children come from the largest families. As figure 7 shows for England, before 1850 two thirds of all children surviving to age 21 come from the one third of men who had 5 or more adult children. Again if reproductive success was a hereditable trait then the characteristics of the population would be changing over time in terms of reproductive success. Figure 8 shows a similar pattern, albeit with larger average family sizes, for Quebec.

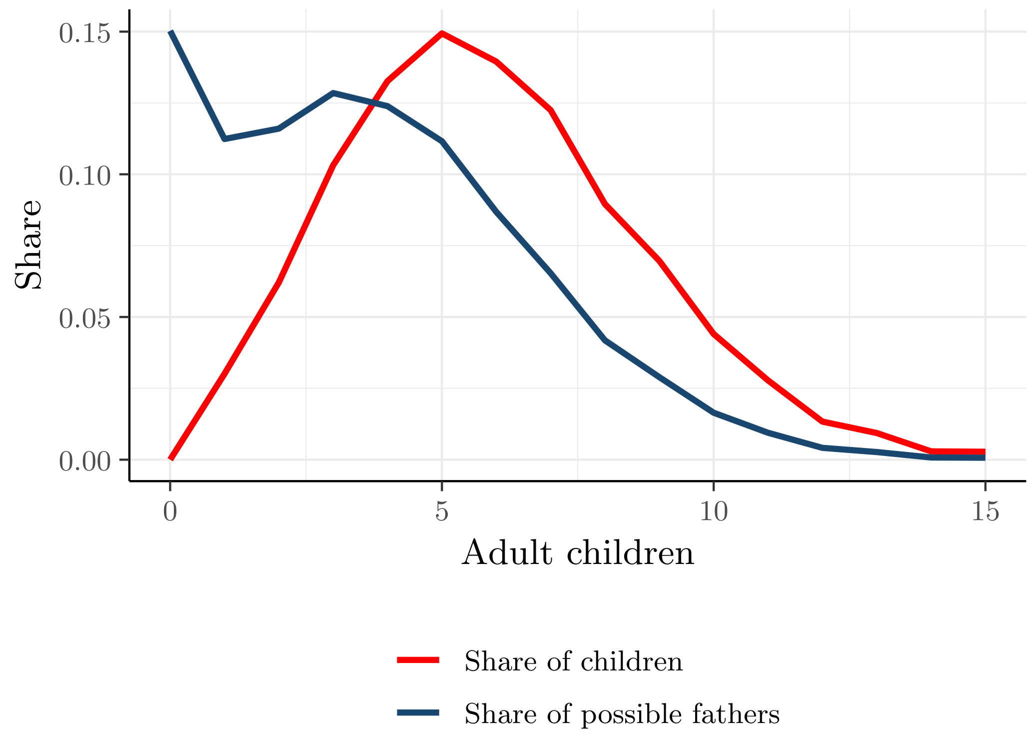

Figure 7: Shares of Child Generation from Different Sibship Sizes, England

Note: Adult children defined as the number of children surviving to age 21+. Sample includes all married men born in England and Wales 1650-1849 with complete fertility observed.

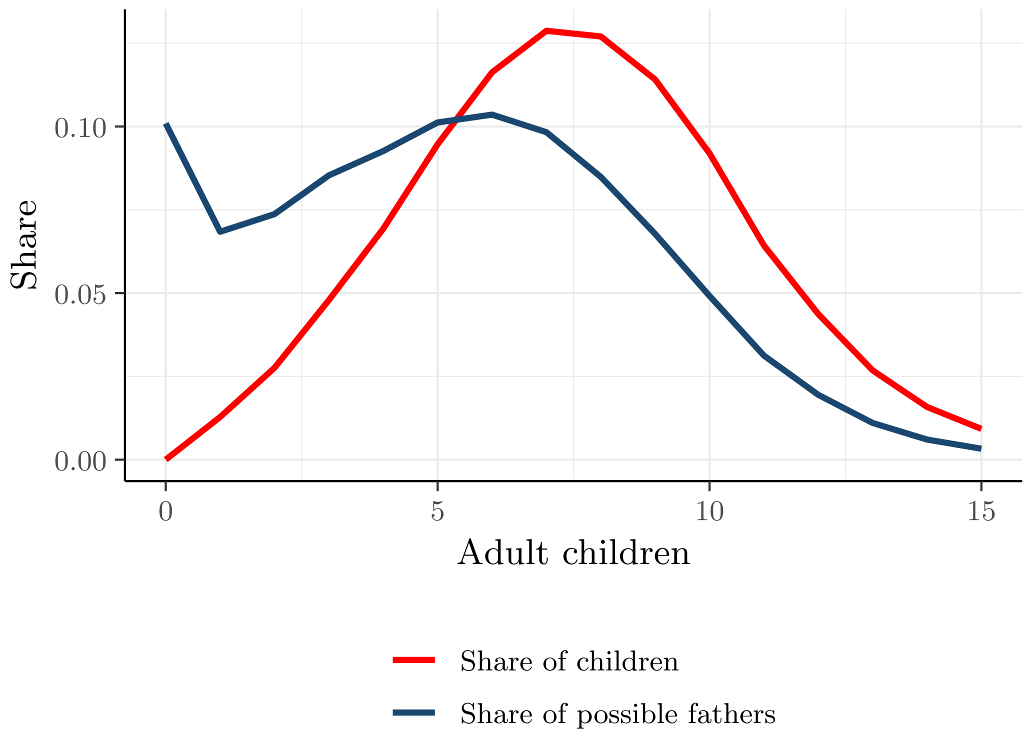

Figure 8: Shares of Child Generation from Different Sibship Sizes, Quebec

Note: Adult children defined as the number of children surviving to age 21+. Sample includes all married men born in Quebec 1600-1788 (so complete fertility is observed).

Table 6 shows the correlation between reproductive success of fathers and mothers and all children, as well as sons and daughters. In all cases, the correlations are very small, in the order of 0.04-0.07.

Table 6: Parent Child Correlations in Net Fertility

	Age at First Marriage			
	England		Quebec	
	Mothers	Fathers	Mothers	Fathers
All children	0.066***	0.060***	0.066***	0.051***
	(0.008)	(0.008)	(0.003)	(0.003)
	15,419	16,184	123,374	110,183
Daughters	0.048***	0.044***	0.070***	0.056***
	(0.014)	(0.014)	(0.004)	(0.004)
	5,003	5,207	63,826	56,649
Sons	0.067***	0.064***	0.059***	0.044***
	(0.010)	(0.010)	(0.004)	(0.004)
	10,416	10,977	59,548	53,534

Note: Adult children defined as the number of children surviving to age 21+. All individuals were born in England and Wales 1650-1849 with complete fertility observed or in Quebec 1600-1788 (so complete fertility is observed). Correlations computed by first standardizing each variable by dividing by one standard deviation then by simple linear regression. Standard errors in parentheses. *p<0.10; **p<0.05; ***p<0.01.

5 How was the EMP transmitted?

The fact that individuals overall inherited the set of behaviors we identify as the European Marriage Pattern in pre-industrial England and Quebec, but systematically did not inherit deviations from the pattern by their own parents remains puzzling.

One potential explanation is that the European Marriage Pattern consists of a strategy towards marriage and reproduction, but a strategy that created actual reproductive behavior such as getting married, or the age at marriage, only with very substantial random elements. The fathers and mothers who deviated from the norms of this pattern were not deviating in terms of strategy, just in terms of how that strategy played out in their circumstances in terms of finding a marriage partner, the age they married, and the realized fecundity of the couple. Some men or women met a potential marital partner who satisfied their criteria early in life, some only later in life, and some not at all.

One test of this explanation for the very low inheritance of marital behaviors would be in the correlation between siblings in such elements of the EMP as age of marriage and celibacy. If the random elements are individually realized, then the correlation will be as low as that of parents. However, as table 7 shows for England and Quebec, the sibling associations in marital behaviors are mostly stronger than the intergenerational associations. Whatever causes changes in marriage pattern behavior, it is more strongly shared between siblings than between parents and children. Perhaps this is explained by within-family dynamics between children (Caron et al 2017) or in local marriage market conditions.

Table 7: Family Member Association of Ages of First Marriage

	Age at first marriage			
	England		Quebec	
	Female	Male	Female	Male
Mother age at first marriage	0.102***		0.080***	
	(0.027)		(0.004)	
Sister age at first marriage	0.161***		0.210***	
	(0.015)		(0.002)	
Father age at first marriage		0.166***		0.106***
		(0.015)		(0.003)
Brother age at first marriage		0.186***		0.224***
		(0.011)		(0.003)
N	4,202	6,473	155,850	143,571

Note: Sample includes all pairs of siblings born in England and Wales 1650-1849 and in Quebec 1600-1849 with observed age at first marriages and with both parent's ages at first marriage observed. Standard errors in parentheses. *p<0.10; **p<0.05; ***p<0.01.

A second potential explanation is that the fertility behaviors associated with the European Marriage Pattern were not copied from parents, but instead were mainly copied from peers or even the broader community. Fertility behaviors were like language pronunciation, where no matter what the parental accent is, children instead adopt the accent of their peers. If behaviors were varying across time and place, then siblings would appear more similar than their parents. Indeed, 7 shows a larger gap between parents and siblings in Quebec, a frontier society, than in England.

6 Conclusion

We have posited here a puzzle of how in any pre-industrial society, such as Northern Europe, fertility limiting behaviors such as the European Marriage Pattern could survive over many generations. It is evident that the fertile are those who inherit the earth, and if their children inherit their proclivities, then restraint cannot persist. One solution proposed to this puzzle is where restrained fertility was actually optimal fertility in terms of long run reproductive success. But we show for both England and Quebec that there was no significant cost in terms of child survival or subsequent child fertility for those who had high fertility.

Here we argue instead that the European Marriage Pattern survived for hundred of years because, for pre-industrial fertility behavior, there was scant familial inheritance of fertility behaviors. Thus fertility enhancing deviations did not get transmitted across generations, and the European Marriage Pattern could persist indefinitely. But while we can at the immediate level resolve the puzzle of the persistence of the

European Marriage Pattern, that resolution creates a new puzzle. Most social behaviors show significant inheritance at the family level. Why were marriage behaviors an exception to this rule? By looking at siblings we can show that this was not just that everyone was inheriting the same marital strategies but getting randomly different realizations. Instead, some factor shared strongly by children — but weakly between parents and children — drove variation in the EMP.

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Appendix 1 Three-generational correlations

Table 8 shows that classical measurement error does not substantially alter our conclusion of weak intergenerational heritability of EMP-related behaviors. The grandparent-grandchild correlation of fertility is higher than the near-zero correlation one would predict purely from the parent-child correlation. This is what one would expect to observe there was inheritance of some latent trait that only loosely translated to observed fertility (c.f. Clark (2014).) However, it is still an extremely weak correlation, meaning that even if deviation from the norm persisted slightly longer than two-generation correlations imply, grandchildren were still much more similar to the general population than their grandparents were.

Table 8: Three-Generation Correlations in Net Fertility

	Quebec			
	Daughter	Daughter	Son	Son
Mother	0.068***			
	(0.004)			
Grandmother		0.043***		
		(0.004)		
Father			0.037***	
			(0.005)	
Grandfather				0.034***
				(0.005)
N	53,473	53,473	38,254	38,254

Note: Net fertility is defined as number of children surviving to age 21+. Sample restricted to groups of three linked individuals where each individual was born in Quebec 1600-1788 (so complete fertility is observed) and had observed family sizes. Correlations computed by first standardizing each variable by dividing by one standard deviation then by simple linear regression. Standard errors in parentheses. *p<0.10; **p<0.05; ***p<0.01.

Appendix 2 Geographic variation

In academic fields such as Political Science and Sociology there is much interest in the competing role of parents versus community in transmitting culture across generations. The empirical investigation of such competing mechanisms of transmission has often relied on studies of the assimilation of the children and grandchildren of immigrants (Bisin and Verdier, 2011). Such studies then track the persistence in the descendants of immigrants of such cultural markers as first names, religion, fertility, or attitudes towards government institutions. But it is hard in such studies to distinguish between parental and peer transmission of culture, since the children of immigrants are potentially exposed to immigrant cultural influences through both paths of influence. Charnysh and Peisakhin (2022) tackle the importance of these different paths of cultural transmission by looking at Polish families that were forcibly relocated from Galicia at the end of WWII to regions in Western Poland that had vacant land and houses because of the expulsions of Germans. Galicia was under Austrian rule from 1772 to 1918, and so Poles from there had a different experience of government and a different system of education than other Poles who in the same years fell under Russian and German rule. Austria, in particular, encouraged education in Polish, facilitated Polish cultural and religious traditions, and held free local elections. In a near random process, some Galician migrants settled in villages where they were a majority group, while others ended up in the minority in their new villages. The study shows that the Galician cultural heritage was more persistent where the community as well as the family was Galician in origin. Respondents in Galicia-majority settlements are now more likely to embrace values associated with the Austrian imperial rule of Galicia, and are more similar to respondents from Western Galicia whose area lay within the postwar Polish territory.

Future research might thus find geographic variation useful to explain how cultural transmission of EMP behavior occurred. Figures 9 and 10 plot the average age at first marriage for women for English counties and Quebec administrative regions during the periods studied. There was notable regional variation within both locations. Explaining the root causes of such regional variation is beyond the scope of this paper, though for England it appears reasonably consistent with previous studies (Reid et al. (2018)).

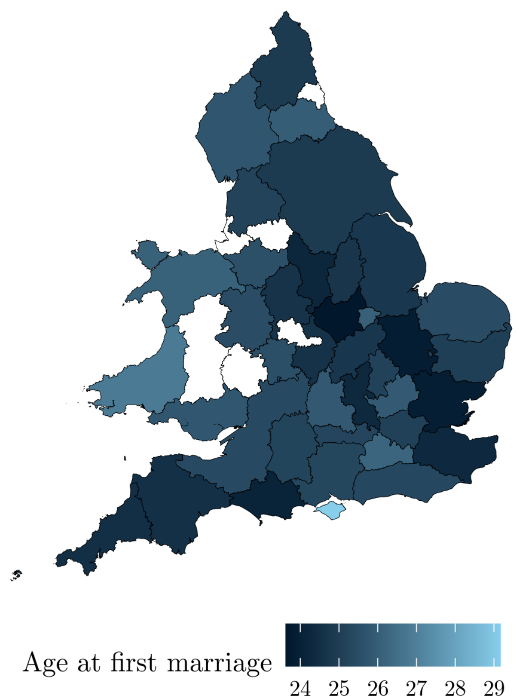

Figure 9: Average Female Marriage Age by County, England

Note: Sample includes all married women born in England and Wales 1650-1849. Due to changing definitions of counties over time, several counties are merged into the smallest consistent unit. Shapefile from Office for National Statistics, Counties and Unitary Authorities, 2016.

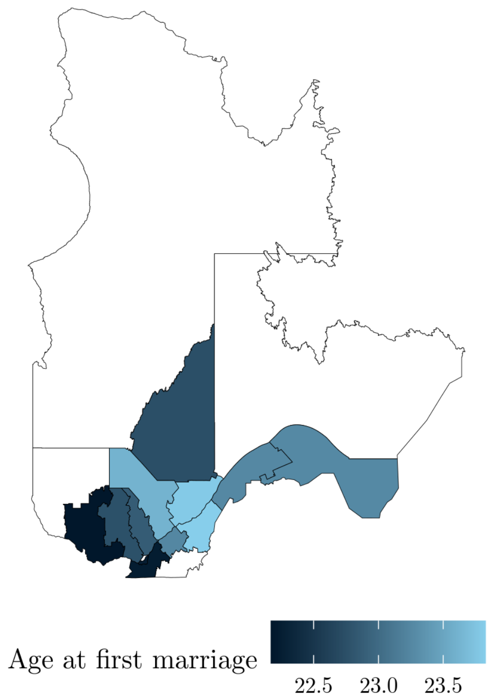

Figure 10: Average Female Marriage Age by Administrative Region, Quebec

Note: Sample includes all married women born in Quebec 1600-1849. Shapefile from Ministère de l'Énergie et des Ressources naturelles du Québec, Carte générale du Québec, 2016.