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A SPECIFICATION OF MARITAL FERTILITY BY PARENTS' AGE, AGE AT MARRIAGE AND MARITAL DURATION

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Abstract—The positive association between wife's age at marriage and fertility experienced at the older reproductive ages, cited in recent natural fertility literature, is explored using Mormon birth cohorts from 1840 to 1879. When this relationship is specified by husband's age at marriage and marriage duration, the results indicate that older-aged husbands depress marital fertility only at higher marriage durations. The general decomposition of age-specific fertility utilizing both mother's and father's age is also considered. The results show that mother's aging is the most important factor, while father's aging has a moderately negative effect under a natural fertility regime.

INTRODUCTION

The search for patterns that underlie fertility rates has focused mainly on the effect of the mother's age. A strong female age effect has been confirmed, and models have been developed using standard age patterns (Coale, 1971, 1972; Coale and Trussell, 1974, 1978; Henry, 1961). Further decomposition of marital fertility rates has allowed other factors to be considered along with the mother's age. Age-specific fertility rates traditionally have been examined for females with different ages at marriage (Henry, 1961). More recently, Page (1977) specified marital fertility by female age and marital duration effects, while Anderson (1975) used female age, male age, and marriage duration. These studies can provide information about both the behavior patterns of couples within specific categories or groups and the general magnitude of particular effects.

The impetus of the present investigation came from the natural fertility literature which deals with the association between marital fertility and the wife's age at marriage. Henry (1961, p. 82) first indicated that in a study of married women of the same age, "fertility was more or less independent of the age at marriage." Studies for Taiwan, India, and the majority of populations of traditional, rural societies were cited as supporting this position. Henry found that Canadian marriages from 1700–1729 were an exception but stated that "certain anomalies lead us to suppose that the connection between fertility and age at marriage is only apparent" (p. 82). More recently Knodel (1978), Charbonneau (1970) and others have observed natural fertility populations for which there is a positive association between age at marriage and age-specific fertility rates. Henry now concludes "that the fertility of married women of the same chronological age decreases with their duration of marriage" (1980, p. 564). Several explanations of this association have been suggested by Knodel (1978). Women who marry earlier have experienced longer marriage durations at each age and thus (a) have a longer exposure to the risk of sterility associated with complications in childbirth or (b) have intercourse less frequently. Additionally (c) the age of

the husband could be a contributing factor. Factors (a) and (b) would be operating in the populations studied earlier by Henry which show no association, as well as in the populations which show a positive association. So the relative age of the husbands may be the most variable factor among different populations and different time periods.[1]

If younger marrying women have husbands considerably older than themselves and older marrying women have husbands closer to their own age, then husband's age may have a depressing effect on the fertility of women who marry at younger ages. Knodel (1978) found this to be the case among villages in pre-industrial Germany. Anderson observed a rise in Russian marital fertility as the average age difference between husbands and wives decreased; but she lacked data to examine the relation fully. Based on an analysis of the 1911 census of Ireland, she concluded "that the age of the husband has some effect on fertility even in the absence of birth control" (1975, p. 566).

Initial tests of two of these proposed explanations were reported by Knodel (1978). He estimated the amount of sterility (no births after age 30) for four marital age groups and found a negative association, but the apparent size of this effect was quite weak. Next he regressed the number of births experienced after age 30 on the wife's age at marriage controlling for the age difference between spouses. The positive association between age at marriage and marital fertility was in general reduced or eliminated.

With the exception of this focused interest on age difference of husband and wife in natural fertility literature, comparatively few fertility studies have analyzed the effect of the age of the male or its interaction with the age of the female.[2] One obvious reason is the difficulty in finding population data which record both mother's and father's age for each birth. Family reconstitutions can provide this level of detail, but they are also typically based on a small number of cases so that cross-classification into a mother/father age matrix with a large number of cells would be imprudent. On the other hand, those adequate data which exist or could be collected would most likely pertain to a population which practiced fertility control. Thus the requirements of adequate size and natural fertility have made it difficult to design a study which specifies marital fertility by both mother's and father's age in order to analyze their joint effects.

The recent development of large sets of longitudinal family data for historical populations provides a unique opportunity to conduct such detailed fertility studies. One such data set has been constructed for the Mormon population beginning with their early settlements in Ohio, Missouri, and Illinois and their final settlement in Utah beginning in 1847. We will present first a brief description of this population and then a detailed analysis of marital fertility for birth cohorts of women covering forty years, 1840–1879. This analysis will include the specification of marital age-specific fertility rates (MASFR) by the wife's and husband's age at marriage. Next, marriage duration will be explicitly added; this specification will allow a comparison with Anderson's results for the Irish. To look further at the general relationship underlying marital fertility, MASFR will be specified simultaneously by mother's and father's age. This overall analysis will allow us to establish the characteristics of particular age groups of husbands and wives and the general magnitude and pattern of the female and male age effect.

POPULATION

The data for this research are derived from computerized Utah genealogies. The project has been described in more detail elsewhere (Bean et al., 1978; Mineau et al., 1979; Skolnick et al., 1978; Skolnick et al., 1979). In brief, the data

are taken from a series of three-generation family group sheets maintained by the Genealogical Society of Utah (Bean et al., 1980). Approximately 170,000 family group sheets were selected from the Society's archives because they showed that at least one individual in the family had experienced a birth or death on the Mormon pioneer trail or in Utah. Thus the family group sheets utilized in the project meet a geographical criterion.

The sheets provide birth date and place, marriage date and place, and death date and place for each spouse along with the names of the parents of each spouse. They also include the birth date and place, marriage date and spouse's name, and death date for each child of this marriage. A marriage is the unit of selection and study; a person having more than one marriage will have more than one family group sheet.

Families chosen for analysis from the project's computer data base consist of once-married couples (husband and wife married only once) in which the wife was born on or between 1840 and 1879, the wife's marriage age was between 15 and 29, and at least one spouse had recorded a death date to "close" the family.

For this analysis the birth cohorts are grouped into two sets:

1. A natural fertility cohort using wives born from 1840 to 1859—This group is comprised of 5,959 frontier families in which the spouses were born along the Mormon pioneer trail, in the first years of Utah settlement, or in Europe and came as converts to Mormon settlements. They average 8.5 children.
2. A transition cohort using wives born from 1860 to 1879—Beginning approximately with the 1860–1864 birth cohort, some type of family limitation was practiced. The average family size dropped from 8.0 for the 1860–1864 cohort to 6.6 for the 1875–1879 cohort. This group is comprised of 13,948 families.

This division into two fertility groups was based on several fertility analyses. First, the indices m and M, measures of fertility control developed by Coale and Trussell, have been calculated for this population based upon MASFRs using ages 20, 21, 22, . . . , 48, 49 and regressing over ages 20 to 44.[3] These authors suggest that " . . . with a series of estimates of $\hat{m}$ over time one can readily interpret their meaning. For example, if one observed a monotonic rise of $\hat{m}$ over time from −0.08 to 1.0, then an estimate of 0.2 in this sequence would be evidence of control" (1978, p. 205). The m value for our population reaches .229 in the 1875–1879 cohort but changes from negative m values to positive m values with the 1860–1864 cohort. Second, in an application of Bongaarts's macrosimulation model using assumptions of no family limitation, the expected values were not significantly different from the observed fertility values for birth cohorts prior to 1860. Those cohorts, born in 1860–1864 and later, practiced increasing levels of fertility control (Willigan et al., 1982). Taken together, these results suggest that the cohorts prior to 1860 were natural fertility cohorts. Using Coale and Trussell's rule of thumb and desiring equal intervals for analysis, we chose two 20-year birth cohorts.

For the most part all vital events are known for each family and no estimation procedures are necessary. However, as with all historical data some pieces of information are missing. In this analysis two imputations are applied at the family level. If a couple is missing a marriage date but their first child has a birth date, a marriage date is estimated for the couple.[4] Second, if only one child in the family is missing a birth date and it is not the last child, a birth date is estimated.[5] These procedures are possible because children are listed in their correct ordinal position whether their birth date is given or not. Unlike family reconstitutions (where these imputations might be unwise), family group sheets are based

upon many sources of information, both personal (family bibles, correspondence, etc.) and public; therefore, children are not likely to be omitted just because their family migrated. However, some families were eliminated from the analysis; these include: (a) families in which the wife's marriage age was not 15–29; (b) families in which neither spouse had a death date; (c) families with more than one child missing a birth date; (d) families in which both the marriage date and first child's birth date were missing; and (e) families with chronologically inconsistent data (due to input or recording errors). These families comprised fewer than 10 percent of the once-married families selected for study.

RESULTS

The once-married Mormon couples show a slight positive association between the wife's age at marriage and the MASFR for both cohorts. In Table 1, rates are presented for three marital age groups: 15–19, 20–24, and 25–29. A partial marital fertility rate (PMFR),[6] calculated across ages 30–49, is shown in the last column. For the natural fertility cohort there is a 12.4 percent increase in the PMFR between the 15–19 and 25–29 marital age groups, with the greatest part of the increase between the 20–24 and 25–29 age groups. For the fertility transition cohort there is no difference between the PMFR of the first two marital age groups, so the entire 9.7 percent increase is for the last age group. Thus it is the 25–29 marital age group that consistently has the highest fertility at the older reproductive ages in this population. These results conform to those cited previously in other populations. To analyze this pattern, we will first introduce husband's age at marriage and then further specify the relationship by including the marriage duration.

The wife's marital age groups are divided into categories by the age of the husband at marriage;[7] this tabulation is presented in Table 2. Women marrying at ages 15–19 are most likely to marry a husband age 20–24 (56 percent in the 1840–1859 cohort and 60 percent in the 1860–1879 cohort) or a husband age 25–29 (21 and 23 percent). Women who marry at ages 20–24 are most likely (53 and 52 percent) to marry a husband in the same age group or the next older age group (30 and 34 percent). The oldest marrying women are most likely (40 and

Table 1.—Marital Age-Specific Fertility Rates by Wife's Age at Marriage and Wife's Birth Cohort

Age at Marriage	N	15–19	20–24	25–29	30–34	35–39	40–44	45–49	PMFR[a] 30–49
					Birth Cohort 1840–1859				
15–19	3227	455.8	455.3	403.8	368.1	310.0	171.9	22.4	4.36
20–24	2180	–	486.5	433.9	383.7	317.1	178.0	24.4	4.52
25–29	552	–	–	469.8	424.9	337.0	186.9	31.9	4.90
					Birth Cohort 1860–1879				
15–19	6228	468.2	444.2	371.5	318.8	256.6	131.6	16.8	3.62
20–24	6244	–	465.8	396.1	322.6	252.2	132.9	16.4	3.62
25–29	1476	–	–	452.5	369.0	274.6	133.5	17.0	3.97

[a] $PMFR = 5 \sum_{30-34}^{45-49} MASFR$

49 percent) to marry in the same age group. Their next choice is someone age 20–24 for the 1840–1859 and someone age 30–34 for the 1860–79 cohorts. This older marital age displays the most variation over time. For each female age group, the mean difference in age of the husband and wife is also shown in Table 2. Younger marrying women have a greater age difference from their husbands than older marrying women.

One might expect that older husbands in each marital age group would depress fertility rates. One could then reason that the positive association is observed in Table 1 because the women who marry at 15–19 are more likely to have older husbands, and the 25-29 year old women are more likely to have the younger husbands. In other words, when the 1840–1859 cohort of women are age 42.5, the women who married at 15–19 would have husbands with a mean age of 48.39 (assuming all married at 17.5), those who married at 22.5 would have husbands age 45.72, and those who married at 27.5 would have husbands age 43.95.

To test for this type of effect, we cross-classified the marital fertility rates by the age of the husband and wife at marriage; the PMFRs are presented in Table 3. The full set of marital age-specific fertility rates is reproduced in the appendix Table A. The general pattern for the natural fertility cohort and fertility transition cohort is that older age husbands do depress fertility behavior for women who married at ages 15–19 or 20–24. Among the women who marry at ages 25–29, there is no consistent pattern; for the 1840–1859 cohort, husbands who marry at ages 35–44 show increased fertility, and for the 1860–1879 cohort, husbands who marry at ages 30–39 show increased fertility. In the earlier cohort this anomaly could be a problem of small number of families, but this is not true of the later cohort.

Specifically, the data in Table 3 indicate that the lowest fertility level for a woman over the ages 30–49 is produced by a 15–19 year old woman marrying a 35–39 year old man (only cells with at least 50 observations are considered). The highest fertility at older ages occurs among women who marry at ages 25–29; in the natural fertility cohort the husband is age 20–24, and in the fertility transition cohort he is age 35–39 at marriage.

However, the general effect of husband's age does not appear to be strong enough to account for the positive relationship between age at marriage and marital fertility in spite of the fact that younger marrying wives are more likely to have older husbands and older marrying wives are more likely to have husbands of similar age. For example, if the PMFRs for the natural fertility cohort, shown in Table 3, are standardized on the distribution of husband's age for women age 20–24 at marriage, then the expected PMFRs for the three ages at marriage of women would be 4.33, 4.52, and 4.97, respectively, instead of the observed 4.36, 4.52, and 4.90 from Table 1. In fact, this standardization increases the range of variation. When the standard is taken as the distribution for women whose age at marriage was 15–19 or 25–29, the range of variation is also increased, and the results are only slightly altered.

If the differential age distribution of husbands does not account for the positive association observed initially, then an alternative consideration is that there is a strong marriage duration effect. For example, at age 42.5, women who married at 17.5 have been married 25 years; those who married at 22.5 have been married 20 years; and those who married at 27.5 have been married only 15 years. If one assumes that the frequency of intercourse is affected by large variations in marriage duration, such as 25 years compared to 15 years, then a two-way analysis of the data is needed.

To analyze the factors in Table 3, one can hypothesize that the age-specific fertility behavior of couples is based on the following model:

Table 2.—Distribution of Age at Marriage of Husband and Wife by Wife's Birth Cohort

Husband's Age at Marriage	Wife's Age at Marriage					
	15-19		20-24		25-29	
	N	%	N	%	N	%
Birth Cohort 1840-1859						
15-19	484	15.0	119	5.5	11	2.0
20-24	1815	56.2	1151	52.8	174	31.5
25-29	680	21.1	656	30.1	217	39.3
30-34	149	4.6	167	7.7	94	17.0
35-39	69	2.1	56	2.6	31	5.6
40-44	20	0.6	20	0.9	9	1.6
≥ 45	10	0.3	11	0.5	16	2.9
Total	3227	99.9	2180	100.1	552	99.9
Age difference						
Mean		5.89		3.22		1.45
Standard deviation		4.58		4.63		6.55
Birth Cohort 1860-1879						
15-19	713	11.4	177	2.8	8	0.5
20-24	3716	59.7	3236	51.8	290	19.6
25-29	1421	22.8	2134	34.2	719	48.7
30-34	274	4.4	532	8.5	313	21.2
35-39	70	1.1	122	2.0	105	7.1
40-44	19	0.3	32	0.5	27	1.8
≥ 45	15	0.2	11	0.2	14	0.9
Total	6228	99.9	6244	100.0	1476	99.8
Age difference						
Mean		5.57		3.33		1.77
Standard deviation		4.02		3.88		4.76

$$\text{MASFR} = \begin{matrix}\text{typical}\\ \text{value}\end{matrix} \times \begin{matrix}\text{wife's marital}\\ \text{age effect}\end{matrix} \times \begin{matrix}\text{husband's marital}\\ \text{age effect}\end{matrix} \times \text{residual} \qquad (1)$$

Taking the log on both sides, we obtain:

$$\ln(\text{MASFR}) = \begin{matrix}\text{typical}\\ \text{value}\end{matrix} + \begin{matrix}\text{wife's marital}\\ \text{age effect}\end{matrix} + \begin{matrix}\text{husband's marital}\\ \text{age effect}\end{matrix} + \text{residual} \qquad (2)$$

This method of summarizing the data allows effects of each factor to be separated (McNeil, 1977, pp. 92–93). A row and column effect can be estimated by a mean polish (Tukey, 1977) to give us some indication of the magnitude and pattern of the two age variables. In this analysis the wife's marital age effect is used as a proxy for a duration effect following the logic of the above discussion. A mean polish was applied to each set of logged MASFRs (30–34, 35–39, 40–44, and 45–49) and an aggregate PMFR calculated over the range 30–49 within each of the cohorts; the results are presented in Table 4. The husbands marrying at age 40 and over were eliminated due to a small number of cases.

Table 3.—Partial Marital Fertility Rate (30–49) by Age at Marriage of Wife and Husband for Women Born 1840–1879

Husband's Age at Marriage	Wife's Age at Marriage		
	15–19	20–24	25–29
	Birth Cohort 1840–1859		
15–19	4.44	4.73	(5.82)
20–24	4.41	4.59	4.94
25–29	4.35	4.46	4.93
30–34	3.99	4.23	4.66
35–39	3.65	4.18	(5.10)
40–44	(3.32)	(3.81)	(5.61)
≥ 45	(2.81)	(4.48)	(3.89)
	Birth Cohort 1860–1879		
15–19	3.92	3.99	(4.87)
20–24	3.66	3.67	4.07
25–29	3.48	3.60	3.85
30–34	3.27	3.39	4.02
35–39	3.02	3.44	4.40
40–44	(2.91)	(2.47)	(3.74)
≥ 45	(2.32)	(2.77)	(3.40)

NOTE: $PMFR = 5 \sum_{30-34}^{45-49} MASFR.$

Parentheses indicate fewer than 50 cases.

Values under 1.0 in Table 4 indicate a negative effect and values over 1.0 a positive effect. The typical values represent average fertility levels.

The fit of these effects is determined by comparing the observed fertility values with the expected values (each cell is the exponentiation of an addition of the typical value, the row effect, and the column effect) and is indicated by an R^2 in Table 4.[8] There is a good fit (over .85) for 60 percent of the sets which always includes the age 30–34 and the aggregate rate over ages 30–49, and a generally medium to poor fit at the oldest ages.

For the cohort born 1840 to 1859, the most negative effect (smallest value) on age-specific fertility is associated with a wife who married at age 15–19 with one exception (ages 40–44), and the next most depressing effect on fertility is associated with a husband who married at age 30–34 or 35–39. The most positive effect occurs either when a wife marries at age 25–29 or when a husband marries at age 15–19. The cohort of 1860–1879 shows a similar pattern of negative effects but with slightly more variation. In terms of positive effects on fertility, the young (15–19) husband tends to have a slightly stronger impact than a wife marrying at age 25–29.

In the last column one observes that wives who marry at ages 15–19 and 20–24 and husbands at ages 30–39 tend to depress fertility at older ages, while wives who marry at 25–29 and husbands at 15–24 increase fertility levels at older ages. In the natural fertility cohort, the most positive and most negative effects are associated with the wife's age at marriage.

To summarize, the positive association between female's age at marriage and fertility rates at age 30 and above is, in general, the result of the shorter duration of marriage for those who marry later. There is also a secondary effect related to the husband's age at marriage. Older husbands do depress fertility, and this effect becomes more pronounced for the natural fertility cohort when analyzing fertility rates at age 40 and above. Thus both factors contribute to the observed association, but the wife's age at marriage is slightly more important when part of the cohort is at a low marriage duration, and husband's age increases in importance as all members of the cohort reach marriage duration of above 15 years.

To substantiate this conditional effect of husband's age, we directly calculated the duration of marriage instead of using wife's marriage age as a proximate indication. Three-way tables based on wife's age at marriage, husband's age at marriage, and marriage duration were tabulated for each set of cohorts; durations 5–9 and 15–19 are shown in Table 5 and Figure 1. These confirm the previous analysis. At a relatively short duration (5–9), there is no consistent pattern of

Table 4.—Effect on Fertility of Female and Male Age at Marriage Using Mean Polish

		Age-Specific Fertility				
		30-34	35-39	40-44	45-49	30-49
		Wife's Birth Cohort 1840-1849				
Wife's age at marriage	15-19	.909	.951	.909	.724	.916
	20-24	.986	.967	1.002	.918	.976
	25-29	1.115	1.088	1.098	1.505	1.118
Husband's age at marriage	15-19	1.055	1.022	1.224	1.576	1.093
	20-24	1.023	1.029	1.044	.991	1.023
	25-29	1.009	1.020	1.006	.911	1.008
	30-34	.986	.965	.863	.767	.994
	35-39	.931	.966	.901	.917	.941
Typical value		385	314	178	27	4540.5
R^2		.88	.54	.77	.65	.88
		Wife's Birth Cohort 1860-1879				
Wife's age at marriage	15-19	.911	.933	.921	.855	.921
	20-24	.971	.944	.982	1.025	.963
	25-29	1.130	1.136	1.106	1.141	1.128
Husband's age at marriage	15-19	1.082	1.154	1.187	1.359	1.130
	20-24	1.002	1.000	1.071	.999	1.012
	25-29	.987	.943	.991	.999	.971
	30-34	.958	.929	.939	1.046	.945
	35-39	.975	.989	.845	.705	.953
Typical value		337	267	129	16	3750.6
R^2		.87	.85	.85	.26	.87

NOTE: Each effect presented is the estimated parameter of equation (1). Thus to obtain the estimated rate for a particular cell, one multiples the effects for that cell and the typical value.

male age effects, but at a higher duration (15–19) the husband's age depresses fertility rates.

We have thus far examined the effect of husband's age on fertility in the context of a particular literature of historical demography, which states a positive relationship between marital fertility and wife's age at marriage, and have found that husband's age at marriage did not explain the positive association. We next turn to a more general problem, that of disentangling the separate effects of wife's and husband's age on marital fertility. A cross-classification of marital fertility by wife's age and husband's age is shown in Table 6 and displayed in Figure 2. To analyze an underlying pattern in these rates, the row effects (wife's age) and column effects (husband's age) are estimated, again using a standard mean polish. Results are shown in Table 7 under columns labeled "2 factor." It must be noted that a control for marriage duration is absent from this analysis. Hence the estimate must be interpreted in light of the fact that age effects subsume whatever duration effects are operating.

From these data several conclusions

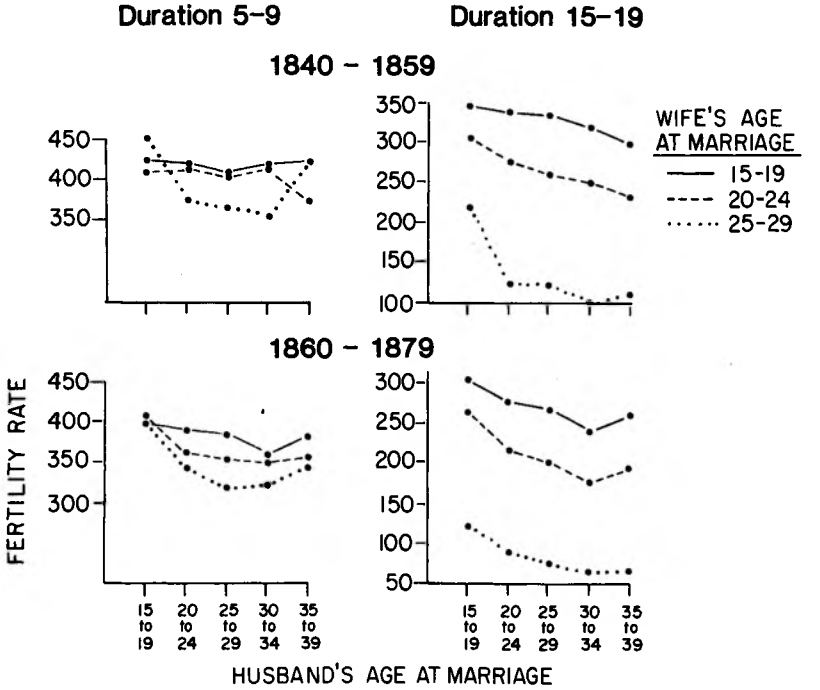

Figure 1.—Duration-Specific Fertility Rates by Age at Marriage of Wife and Husband for Birth Cohorts 1840–1879 (taken from Table 5)

can be drawn. First, the wife's age is more important than the husband's age, as one would suspect. This result is shown graphically in Figure 2; the gap between curves is the aging effect of women. The only bunching that occurs is for the younger ages in the natural fertility cohort; otherwise, the curves are

Table 5.—Duration-Specific Fertility Rates by Age at Marriage of Wife and Husband for Birth Cohorts 1840–1879

Husband's Age at Marriage	Wife's Age at Marriage					
	Marriage Duration 5-9			Marriage Duration 15-19		
	15-19	20-24	25-29	15-19	20-24	25-29
	Birth Cohort 1840-1859					
15-19	425.5	410.7	454.5	347.0	308.8	222.2
20-24	422.9	417.0	378.0	339.4	278.2	126.2
25-29	411.6	408.8	368.5	336.4	263.6	124.4
30-34	421.5	416.6	358.5	321.3	252.7	101.9
35-39	425.5	378.6	427.7	300.4	236.6	111.8
	Birth Cohort 1840-1859					
15-19	401.5	408.7	400.0	307.1	268.5	125.0
20-24	391.3	362.8	344.0	280.3	221.0	93.8
25-29	386.5	355.3	319.7	274.0	205.0	78.0
30-34	360.9	349.9	322.4	243.8	179.2	68.3
35-39	383.4	355.6	344.5	262.2	198.0	67.5

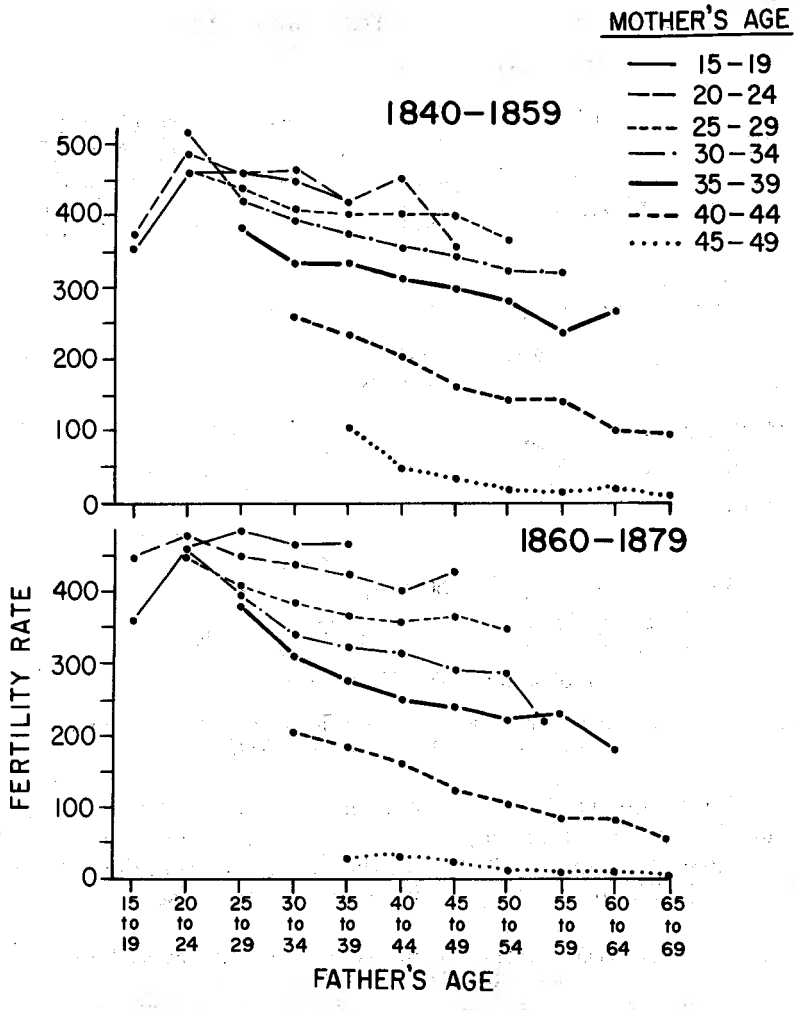

Figure 2.—Marital Age-Specific Fertility Rates by Mother's and Father's Age by Mother's Birth Cohort (taken from Table 6)

quite separate and distinct. Also, in Table 7 the largest positive and negative values are related to the wife's age.

Given that wife's aging is the most important factor, one does observe a moderate aging pattern for husbands. Specifically, in Table 6 within each wife's age group, having an older husband depresses fertility; in Table 7 a male aging effect is also apparent. In Figure 2 the slope of each curve indicates the effect of male's age within each age-grouping of females; husband's age presents a distinct negative slope where the wife's age is 25–29 or above. Thus the age of the husband can affect fertility experience with older men, in general, acting as a depressant.

Since duration effects may contaminate the age effects estimates in the two-factor model shown in Table 7, we push the analysis one step further by estimating a model including a specific duration effect as well as age effects of husband

Table 6.—Marital Age-Specific Fertility Rates by Mother's and Father's Age by Mother's Birth Cohort

Father's Age	Mother's Age						
	15-19	20-24	25-29	30-34	35-39	40-44	45-49
			Birth Cohort 1840-1859				
15-19	353.3	376.9	-	-	-	-	-
20-24	459.9	488.5	462.2	517.4	-	-	-
25-29	463.2	457.7	439.3	421.9	382.5	-	-
30-34	452.8	462.7	411.8	397.5	337.1	259.8	-
35-39	423.6	421.5	402.7	376.4	335.1	234.8	102.4
40-44	(499.4)	454.2	404.4	356.5	314.2	203.6	47.1
45-49	-	361.2	403.7	345.4	301.3	163.0	32.7
50-54	-	(414.7)	367.5	325.2	281.4	144.3	18.7
55-59	-	-	(386.5)	322.1	237.3	142.9	14.7
60-64	-	-	-	(355.0)	293.2	101.8	19.8
65-69	-	-	-	-	(228.0)	94.7	9.1
			Birth Cohort 1860-1879				
15-19	361.6	447.6	-	-	-	-	-
20-24	463.1	477.7	448.0	459.5	-	-	-
25-29	484.0	450.2	409.7	396.4	381.1	-	-
30-34	466.4	440.5	384.2	340.2	309.8	205.2	-
35-39	467.8	423.0	367.2	323.7	276.7	185.6	28.0
40-44	(440.4)	402.6	360.0	314.5	251.3	159.3	34.1
45-49	-	429.5	366.5	291.0	241.8	123.2	22.6
50-54	-	-	348.0	284.4	221.2	104.4	13.2
55-59	-	-	-	246.8	228.0	82.5	9.3
60-64	-	-	-	(329.0)	179.3	82.0	11.1
65-69	-	-	-	-	-	54.7	5.0

NOTE: Cells with a denominator (exposure years) less than 50 have been omitted and those with less than 100 have been put in parentheses.

and wife. To do so we considered tables like Table 6 separately for duration groups 0–4 through 15–19. Results are shown in the columns labeled "3 factor" in Table 7. Examination of the results for the 2 and 3 factor models shows clearly that adding duration as a factor decreases the female effect gradient for both cohorts and the male effect gradient for the transition cohort. For the natural fertility cohort, the male effect gradient is not reduced and is perhaps increased slightly because of one extremely low value at age 55–59. Nevertheless, the qualitative conclusions drawn earlier still hold even when duration is controlled. The effect of aging of the female far exceeds the effect of aging of the male in depressing fertility.

SUMMARY

This paper has addressed the age of the husband as a possible factor which could explain the observed positive relation between age at marriage of women and fertility rates after age 30. The data presented lead us to conclude that the positive relation is caused by the fact that women with older ages at marriage have shorter marriage durations. This conclusion is not really an explanation, since fertility could fall with duration for at least two reasons: greater sterility due to longer exposure to childbearing, or declines in frequency of intercourse. We would tend to support the latter explanation, though we have no independent evidence upon which to base a judgment.

Table 7.—Mean Polish of MASFR Using 2-Factor and 3-Factor Models

		1840-1859 Cohort		1860-1879 Cohort	
		# Factors		# Factors	
		2	3	2	3
Mother age effect	15-19	1.511	1.199	1.799	1.415
	20-24	1.564	1.243	1.814	1.491
	25-29	1.539	1.285	1.641	1.452
	30-34	1.470	1.229	1.570	1.290
	35-39	1.235	1.115	1.267	1.147
	40-44	.703	.773	.655	.669
	45-49	.131	.179	.095	.098
Father age effect	15-19	.919	.979	1.040	.918
	20-24	1.226	1.082	1.267	1.106
	25-29	1.146	1.066	1.230	1.121
	30-34	1.138	1.120	1.168	1.096
	35-39	1.246	1.054	1.139	1.035
	40-44	1.112	.900	1.105	1.052
	45-49	.937	.887	.978	.916
	50-54	.824	.790	.802	.899
	55-59	.731	.522	.639	.765
	60-64	.728	—	.675	.623
Duration effect	0-4		1.157		1.183
	5-9		1.030		.995
	10-14		.937		.906
	15-19		.917		.930
Typical value		258	303	214	256
R^2		.908	.921	.950	.943

NOTE: See note to Table 4.

It would appear (from Figure 2, for example) that the husband's age has an independent and moderately strong effect on fertility only for high durations of marriage and when the husband is either very much older or younger than the wife.

Anderson's study of the 1911 Irish census displays a negative husband's age effect on fertility for marital duration 5–9, unlike that in the Mormon data. However, this pattern exists only for men married after approximately age 37.5 who are 42.5 or older during this duration. Also the negative effect does not appear to become stronger at duration 10–14 (and may even weaken); again this finding is opposite that in the Mormon data in which the husband's age effect is becoming apparent (not shown). Anderson's contention that about half of the rise (half of 51 percent) in the level of marital fertility observed in rural Uzibekistan between 1926 and 1970 could be explained by a shrinking of the age difference between spouses of three years (from nine to six years) does not seem to be supported by her Irish data or by our data.

Finally, we would conclude (from Tables 6 and 7, for example) that the depressive effect on marital fertility of increasing age is much greater for the wife than for the husband. It is difficult to quantify precisely this difference, but a simple calculation may help. Consider a woman age 20 who marries a man age 25. From the estimated coefficients given in

the two-factor model in Table 7 for the natural fertility cohort, we see that by age 50 the couple would have produced 9.69 children. Now imagine the counterfactual circumstance in which the partner(s) did not age. If neither aged, they would in 30 years produce 13.87 children; if only the wife or husband aged, respectively, they would have 9.82 and 12.92 children. Such estimates are only approximate, of course, since all other confounding variables (like duration) are ignored.[9] Viewed in this way, aging reduces fertility by 30 percent, while aging of the wife alone reduces it 29 percent and of the husband alone by only 7 percent. It is only these relative differences that we wish to stress here.

Some final thoughts in terms of more general implications of these data are appropriate. The population presented above had the following characteristics: women married young, and the age difference between once-married husbands and wives was not extremely large. Specifically for the Mormon natural fertility cohort, 54 percent of the women married before age 20 and therefore experienced long marriage durations during their reproductive ages, while about 11 percent married at age 25 or older (9.3 percent at 25–29) and experienced shorter marriage durations. Due to this young age pattern of marriage among the Mormons, we would conclude that the fertility rates at age 30 and above for the population are being significantly depressed because many couples have a long marriage duration. In other words, those women who married at ages 15–19 and have the lowest fertility at age 30 and above make up over half of the population of once-married couples. In populations where the woman's average age at first marriage is fairly old (say over 25), proportionately few couples will ever reach marriage durations of 25 to 30 years during the wife's reproductive ages, and most couples will be at a short marriage duration when the wife is in her thirties. Since the (relatively small) depressive effect of increased husband's age becomes apparent only at the higher durations of marriage, husband's age as a factor underlying the level of fertility should be less important in late marrying populations.

In some populations where there may exist a large proportion of older husbands marrying younger wives or in others where many wives may be older than their husbands, husband's age relative to wife's age could be a significant factor affecting marital fertility, and any major change in their pattern of age difference would also be expected to be significant. However, in many populations, as among these once-married Mormons, the age difference between the husband and wife is not large, and thus it is doubtful that husband's age is the major contributing factor to the observed relationship between age at marriage and fertility.

Finally, our analysis is confined solely to effects of factors on fertility experience at older ages. Among once-married Mormons as well as other populations, it was found that the older the wife at marriage, the higher the age-specific fertility at older ages. This finding does not, however, indicate that delayed marriage will raise overall fertility (e.g., total fertility rate) in the population, because the higher fertility at the older reproductive ages cannot compensate for shortening the length of exposure to childbearing.

NOTES

[1] It should be noted, however, that in at least one population, the Cocos Keeling Islanders, a negative effect between age at marriage and marital fertility rates is observed (Smith, 1960). Coale attributes this relationship to selectivity; the more fecund women form unions earlier because they become pregnant at an earlier age.

[2] The effect of husband's age has been explicitly included in the simulation model of Bongaarts (1977), and Brouard (1976) has published a study on male fertility.

[3] The m values have been calculated using the modification which allows m and M to be estimated by ordinary least squares. A computer program to

produce these values is available in Coale and Trussell (1978). The values are shown below:

	m	*M*	*Mean sq. error*
1840–44	−.093	.943	.0045
1845–49	−.051	.962	.0020
1850–54	−.059	.940	.0022
1855–59	−.027	.946	.0026
1860–64	.082	.958	.0020
1865–69	.081	.924	.0024
1870–74	.148	.929	.0020
1875–79	.229	.926	.0017

[4] The year of marriage is estimated by subtracting 1.30 years from the first child's birth date. This mean interval was determined by using families with no missing dates. In other analyses the mean age at first birth has been compared for those with and without marriage information; for the 1840–1869 birth cohort, it was 21.74 and 22.35 respectively with 8.5 percent missing the data; for the 1870–1899 cohort it was 22.91 and 22.17 with 2.0 percent missing the data.

[5] The estimate is the midpoint between the previous birth and the next birth. If it is the first child in a family of two or more, the missing birth date is placed between the marriage date and the second child's birth as follows:

interval (2nd birth − marriage) × .37 + marriage date.

[6] The fertility measure, PMFR, is the sum of the MASFRs from age 30–34 to age 45–49 multiplied by 5. It is a synthetic measure of the number of children which would be born to a woman over the age span 30–49.

[7] In our initial work we produced a cross-classification using age difference between husband and wife rather than the father's age at marriage. Using a set of four categories (wife older or same age, husband 1–4 years older, husband 5–9 years older, and husband 10 or more years older), we found results similar to those presented here.

[8] R^2 were calculated using the observed and fitted MASFR with natural scale, where the fitted MASFR = exp(typical effect + wife's age effect + husband's age effect). Cells based on fewer than 50 observations were treated as structural zeroes and were not included at all in the analysis. $R^2 = 1 - MSE/\text{Var}$ where *MSE* is the mean of the squared error between observed and fitted and Var equals the variance of the observed.

[9] If a similar analysis is performed using the three-factor model, then similar results emerge. However, only the first 20 years of marriage can be considered.

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Table A.—Marital Age-Specific Fertility Rates by Husband's and Wife's Age at Marriage

Husband's Age at Marriage	Age 15-19	20-24	25-29	30-34	35-39	40-44	45-49
Cohort 1840-1859							
Wife's Age at Marriage 15-19							
15-19	447.2	444.3	404.2	378.8	307.4	178.7	23.8
20-24	456.2	456.2	405.3	373.8	314.2	171.8	22.6
25-29	456.8	466.1	401.9	362.5	310.4	176.1	22.0
30-34	480.2	449.0	407.7	337.0	285.3	151.0	25.0
35-39	459.2	440.6	399.6	301.7	284.7	134.9	8.9
40-44	(410.4)	430.0	367.6	295.7	260.0	109.1	0.0
≥ 45	(491.8)	340.0	280.0	(211.9)	(190.7)	(158.7)	(0.0)
Wife's Age at Marriage 20-24							
15-19	--	463.8	438.7	388.0	319.9	203.7	34.1
20-24	--	485.9	435.1	386.3	322.9	181.6	27.1
25-29	--	493.7	434.0	383.4	315.6	174.5	19.1
30-34	--	494.8	437.6	365.0	307.6	155.2	18.8
35-39	--	452.9	392.9	374.0	256.5	179.3	26.0
40-44	--	(471.5)	400.0	367.6	259.6	111.1	23.7
≥ 45	--	(494.7)	472.7	454.5	(291.7)	(150.0)	(0.0)
Wife's Age at Marriage 25-29							
15-19	--	--	(455.1)	454.5	335.3	(283.1)	(90.5)
20-24	--	--	483.9	422.1	331.6	205.4	29.8
25-29	--	--	472.0	420.4	344.8	186.6	33.7
30-34	--	--	465.9	443.0	317.0	154.2	18.0
35-39	--	--	440.7	406.5	382.0	170.0	62.5
40-44	--	--	(521.4)	(511.1)	(376.2)	(233.9)	(0.0)
≥ 45	--	--	351.5	376.8	285.7	(81.3)	(34.4)
Cohort 1860-1879							
Wife's Age at Marriage 15-19							
15-19	461.4	435.8	382.9	339.7	277.2	144.2	22.3
20-24	466.4	447.3	374.1	318.9	260.3	135.4	16.4
25-29	480.6	443.9	366.4	315.8	243.6	121.3	15.0
30-34	450.6	434.4	335.4	292.2	229.8	111.7	20.4
35-39	465.7	425.7	372.5	273.5	237.7	88.9	4.2
40-44	(508.4)	442.1	360.5	266.7	208.2	94.1	12.5
≥ 45	(415.4)	371.4	328.6	295.4	127.7	40.0	(0.0)
Wife's Age at Marriage 20-24							
15-19	--	466.0	413.9	357.0	281.0	141.6	18.2
20-24	--	465.5	393.5	323.0	256.0	137.4	17.8
25-29	--	467.7	399.4	322.6	250.1	131.5	15.3
30-34	--	460.0	396.5	313.4	238.5	114.5	12.2
35-39	--	467.3	392.3	321.6	236.4	110.4	19.2
40-44	--	434.4	343.8	255.2	149.9	89.7	0.0
≥ 45	--	(511.8)	418.2	290.9	163.6	98.6	(0.0)
Wife's Age at Marriage 25-29							
15-19	--	--	(504.6)	(400.0)	(375.0)	(175.0)	(25.0)
20-24	--	--	460.1	373.9	286.0	141.2	13.8
25-29	--	--	447.8	361.0	261.8	130.4	17.6
30-34	--	--	458.0	367.7	278.8	138.4	18.6
35-39	--	--	454.7	403.4	327.4	131.6	17.6
40-44	--	--	430.2	407.4	214.8	109.3	16.1
≥ 45	--	--	(404.3)	352.4	276.9	50.6	(0.0)

NOTE: Parentheses indicate fewer than 50 exposure years.