Timely Statistics Vindicate the Prophet

David Keller[1]

We will now quantitatively address the question of whether the Joseph Smith's wives' marital ages were normal relative to their peers. After briefly presenting Joseph's wives, we will introduce some statistical measures commonly used in demographics scholarship along with some methods used for estimating them. Then we will combine these methods with conventional scholarly wisdom about marriage trends in the first half of the 19th century to recover the marriage market dynamics of Illinois in 1840. While the plurality of Joseph Smith's marriages was taboo for his era, collectively the ages of his brides will be shown to be a product of environment.

Following Todd Compton's enumeration[2], Joseph Smith's plural marriages to 33 wives are listed below in Table 1. Anderson and Faulring[3] contested 4 of these wives (14 or 15 year old Nancy Winchester and 3 non-teens) on the grounds of insufficient evidence. They favor accounts of Fanny Alger's marriage being in 1835 rather than early 1833. Fanny Alger was likely born at least a year earlier than erroneous family group sheets report[4]. George D. Smith's compilation[5] of Joseph Smith's plural wives removes one teenage bride and adds ten post-teenagers. The effect of these changes is that the average age difference between Joseph and his wives would drop by over two years (6.7

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[1] This paper was written as a draft of the author's contribution to a recent publication. See Craig L. Foster, David Keller, and Gregory L. Smith, "The Age Joseph Smith's Plural Wives in Social and Demographic Context," in Newell G. Bringhurst and Craig L. Foster eds., *The Persistence of Polygamy: Joseph Smith and the Origins of Mormon Polygamy*, (Independence, John Whitmer Books Press 2010), 152-183

[2] Todd M. Compton, *In Sacred Loneliness*, (Salt Lake City: Signature Books, 1997). We have estimated some of the dates.

[3] Richard L. Anderson and Scott Faulring, "The Prophet Joseph Smith and his Plural Wives," *FARMS Review of Books* 10:2 (1998):67-104

[4] David Keller, "The Fanny Alger Marriage," fairblog.org (31 May 2009) <http://www.fairblog.org/2009/05/31/the-fanny-alger-marriage/>

[5] George D. Smith, "Nauvoo Roots of Mormon Polygamy, 1841-46: A Preliminary Demographic Report," Dialogue 27:1 (1994):60-61

years down to 4.6) as would the percentage of teenagers (30% vs. 21). In addressing whether the ages of Joseph Smith's wives were normal for their society, it is desirable to utilize the worst case scenario and retain Compton's list.

Table1: Joseph Smith's Plural Wives

Wife	Birth	Marriage	Age	Gap
Helen Kimball	22-Aug-28	*1-May-43*	14.7	22.7
Nancy Winchester	10-Aug-28	**30-Jun-43**	14.9	22.6
Fanny Alger	20-Sep-16	**1-Apr-33**	16.5	10.8
Flora Woodworth	14-Nov-26	**1-Mar-43**	16.3	20.9
Sarah Lawrence	13-May-26	*1-May-43*	17.0	20.4
Lucy Walker	30-Apr-26	1-May-43	17.0	20.4
Sarah Whitney	22-Mar-25	27-Jul-42	17.4	19.3
Emily Partridge	28-Feb-24	4-Mar-43	19.0	18.2
Maria Lawrence	18-Dec-23	*1-May-43*	19.4	18.0
Melissa Lott	9-Jan-24	20-Sep-43	19.7	18.1
Zina Huntington*	31-Jan-21	27-Oct-41	20.8	15.1
Eliza Partridge	20-Apr-20	8-Mar-43	22.9	14.3
Sylvia Sessions*	31-Jul-18	8-Feb-42	23.5	12.6
Mary Rollins*	8-Apr-18	*25-Feb-42*	23.9	12.3
Louisa Beaman	7-Feb-15	5-Apr-41	26.2	9.1
Marinda Johnson*	28-Jun-15	*1-Apr-42*	26.8	9.5
Olive Frost	24-Jul-16	**1-Jul-43**	27.0	10.6
Elvira Cowles*	23-Nov-13	1-Jun-43	29.5	7.9
Hannah Ells	**1-Jan-13**	**30-May-43**	30.4	7.0
Almera Johnson	12-Oct-12	*2-Apr-43*	30.5	6.8
Presendia Huntington*	7-Sep-10	11-Dec-41	31.3	4.7
Agnes Coolbrith*	9-Jul-08	6-Jan-42	33.5	2.5
Desdemona Fullmer	6-Oct-09	*1-Jul-43*	33.8	3.8
Ruth Vose*	26-Feb-08	*1-Feb-43*	35.0	2.2
Delcena Johnson*	19-Nov-06	**1-Jul-42**	35.6	0.9
Lucinda Pendleton*	27-Sep-01	**1-Jan-38**	36.3	-4.2
Martha McBride*	17-Mar-05	*1-Aug-42*	37.4	-0.8
Eliza Roxcy Snow	21-Jan-04	29-Jun-42	38.5	-1.9
Patty Bartlett*	4-Feb-95	9-Mar-42	47.1	-10.9
Elizabeth Davis*	11-Mar-91	**30-May-42**	51.3	-14.8
Sarah Kingsley*	20-Oct-88	**29-Jun-42**	53.7	-17.2
Fanny Young*	8-Nov-87	2-Nov-43	56.0	-18.1
Rhoda Richards	8-Aug-84	12-Jun-43	58.9	-21.4

Notes: * (previously married), **bold** (broadly estimated date)
italics (estimates are within month)

Sources of marriage data can be categorized based on whether it is more convenient to extract information on marriage-year or birth-year cohorts. Most US census records since 1850 can be analyzed in both categories, but the latter has come to dominate fertility studies. One reason is that available sample sizes across birth-year cohorts are much larger and therefore more accurate and stable. A second is that birth-year cohort data can be easily normalized to be age independent, thus relatively immune to the large variations in a population's age structure such as seen in fig. 1 for white females in the 1880 census. While setting a standard, fertility studies often ignore remarriages, companionship marriages over age 50 or under age 15 (due to small sample sizes and high illegitimacy rates).

It is more suitable to compare Joseph Smith's marriage cohort with age dependent statistics, as they are more representative of marriage market activity over a short timeframe. Records that are naturally age dependent contain chronological listings of marriages that include brides' ages, often in completed birth years. Municipal, county, church, and other genealogical records are scattered throughout the 19th century. We will discuss a method for converting from age independent to age dependent statistics below and use some appropriately selected county records for verification.

The 1880 federal Census is an ideal to start an analysis of nuptiality. Although taken almost 40 years after most of Joseph Smith's plural marriages, it was the earliest census which reported on marital status for each individual entry. The Integrated Public Use Microdata Series (IPUMS)[6] (a database that tracks important demographic variables

[6] Steven Ruggles, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek. *Integrated Public Use Microdata Series: Version 5.0* [Machine-readable database]. Minneapolis: University of Minnesota, 2010.**,** accessed 18 Mar 2010. <http://usa.ipums.org/usa/>

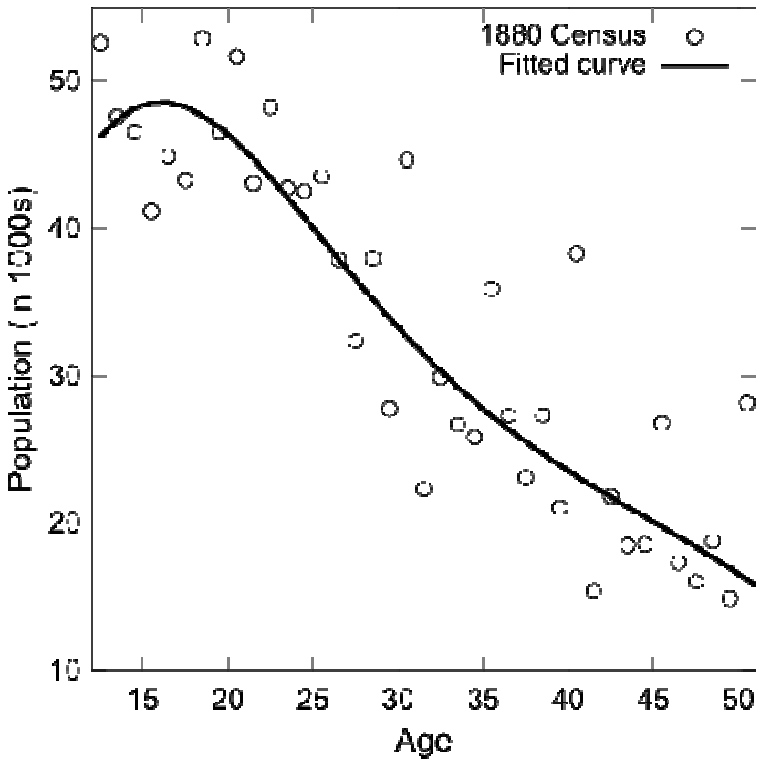

Figure 1: 1880 white female population by age from IPUMS (10% sample). Note the steep decline with increasing age and the tendency of reported ages to cluster at multiples of 5and 10.

tracking 1% - 10% of the US population during census years) will aid in illustrating new concepts. After exploring national statistics for 1880, we discuss assumptions that will allow for estimating them from 1800 to 2008. Before zeroing in on 1840 Illinois, we will work our way backwards from 1880 and survey regional activity in the US and in the Midwest.

The marital statistics that are most easily extracted from the 1880 Census using IPUMS data are cumulative Age Specific First Marriage Rates (ASFMR). This can be defined as the ratio of ever-married individuals to total individuals within a specified age range. Table 2, which illustrates cumulative ASFMR, was generated using IPUMS's online analysis tool by

1) adding Sex(=female) and Race(=white) variables as filters to isolate the white female population,

2) breaking down this population by Age (at last birthday) and Marst (by marital status whether single or married) cases into rows and columns as in Table 1,

3) and dividing the total ever-married by the total population in each age group to obtain the cumulative ASFMR (given in bold in Table 1).

Table 1: Cumulative ASFMR from 1880 IPUMS data

Bold: percent Regular: cases		**Age**								
		12	13	14	15	16	17	18	19	20
Marst	married	**.0** 21	**.1** 45	**.4** 173	**1.2** 513	**4.0** 1797	**8.5** 3695	**15.9** 8415	**24.2** 11268	**33.7** 17419
	single	52574	47547	46390	40672	43096	39595	44500	35246	34263
	TOTAL	*52595*	*47592*	*46563*	*41185*	*44893*	*43290*	*52915*	*46514*	*51682*

It is important to note that the reported age in Census records or county marriage records is on average a half year younger than actual age. This means that the percentage of a birth cohort[7] marrying before turning 20 (as teenagers) would have to be interpolated at an intermediate value between 24.2% and 33.7%. The Coale-McNeil model[8] provides a convenient way to perform such interpolations.

[7] See Technical Note 1.
[8] See Technical Note 2.

In 1971, Coale[9] found that the marital age profile typically follows a standard pattern, regardless of the society being analyzed. He observed that the general pattern could be linearly transformed to match a specific society's ASFMR. Only three parameters are needed for shifting, spreading, and scaling the standard curve to fit to data gathered from a country or region. The scaling parameter gives an estimate of the percentage of women within a cohort who will marry sometime in their lifetime. This parameter has been called the total marriage rate (TMR)[10] in demographics literature[11]. For the last two centuries TMR has ranged from 90-96% in the United States[12].

The shifting parameter of the Coale-McNeil model corresponds to the mean age at first marriage[13]. It can be approximated by the singulate mean age at marriage (SMAM) which is the average number of years that eventually wed woman will remain single. Sanderson[14] as tabulated in Haines[15] estimated SMAM to vary between 19.5 to 22.8 years from 1800 and 1920. We adopt a more widely held consensus, first proposed by Smith[16], that SMAM only reached as low as 21.0 in 1800.

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[9] Ansley J. Coale, "Age Patterns of Marriage," *Population Studies* 25:2 (1971), p. 193-214. See also A.J. Coale and D. R. McNeil, "The Distribution by Age of the Frequency of First Marriage in Female Cohort." *Journal of American Statistical Association* 67 (1972): 743-749.

[10] See Technical Note 3.

[11] Colin Newell, *Methods and Models in Demography*, Guilford Press, NYC (1988) p. 90-104.

[12]] Catherine A Fitch and Steven Ruggles, "Historical Trends in Marriage Formation: The United States 1850-1990." In *The Ties that Bind: Perspectives on Marriage and Cohabitation.* Linda J. Waite, Ed. New York: Aldine de Gruyter (2000), p. 74.

[13] See Technical Note 4.

[14] Warren C. Sanderson, "Quantitative Aspects of Marriage, Fertility and Family Limitation in Nineteenth Century America: Another Application of the Coale Specification." *Demography* 16, (1979): 339-358.

[15] Michael R. Haines, "Long Term Marriage Patterns in the United States from Colonial Times to the Present," National Bureau of Economic Research (Cambridge, MA), NBER Working Paper Series, (Historical Paper No. 80. 1996) p. 31.

[16] Daniel S. Smith, "American family and demographic patterns and the north-west European model," *Continuity and Change,* 8:3(1993): 389-415.

The spreading parameter of the Coale-McNeil model must be chosen to align the standard nuptial schedule at the minimum age of eligibility[17], a benchmark that Coale[18] set for "the earliest age of a significant number of first marriages," This measure depends on age laws, the onset of menarche[19], and traditional community standards; however it needs to quantified by empirical observations before it can be useful. Sanderson[20] estimated that the minimum age varied from 14.0 to 14.4 for 1800 to 1920. As will be seen, our analysis yields slightly lower results during the same period of 13.5 to 14.0. The spreading parameter is technically the standard deviation about the mean age.

Figure 2 visually shows how the standardized (having a mean of zero and a standard deviation of one) formulation of the Coale-McNeil equation can be shifted, spread, and scaled to match 1880 Census data for white females[21]. Of the curves plotted in fig. 2, the best comparison to Joseph Smith's plural wives is actually the curve that has been optimally shifted and spread, but not yet scaled. To state the obvious, none of Joseph's wives would belong to the 7.0% of the female population that the model projects will never married despite living past age 50. The same is true of brides whose names appear on county marriage records. From this point forward, we will remove the effect of the never-marrieds by scaling census ASFMRs upwards by the inverse of the TMR and using the unscaled version of the Coale-McNeil model. With this adjustment, the age independent teenage marriage rate in 1880 moves from 28.1% to 30.2%.

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[17] See Technical Note 5.
[18] Coale (1971) p. 206.
[19] Useful publications on 19th century menarche statistics include Grace Wyshak "Secular changes in age at menarche in a sample of US women" *Annals of Human Biology*, 10:1 (1983):75-77; P. E. Brown, "The Age at Menarche," *British Journal of Preventive and Social Medicine,* 20 (1966):9-14; and Peter Laslett, *Family life and illicit love in earlier generations* (1977, New York : Cambridge University Press).
[20] Sanderson (1979) p. 341.
[21] See Technical Note 6.

Typically the mean, mode, and median of a probability distribution are envisioned to be about the same (as they are in the standard bell curve). Based on that assumption, one might conclude, from a mean of 23.2 or SMAM of 23.5, that teenage marriage was rare for white America in 1880. In fact, the Coale-McNeil model predicts that the mean age will always occur after about 60% have already been married! As shown in fig. 3, the median (the age at which 50% have been married) occurs almost a year earlier. The mode, or peak, of the probability distribution actually occurs close to age 20.

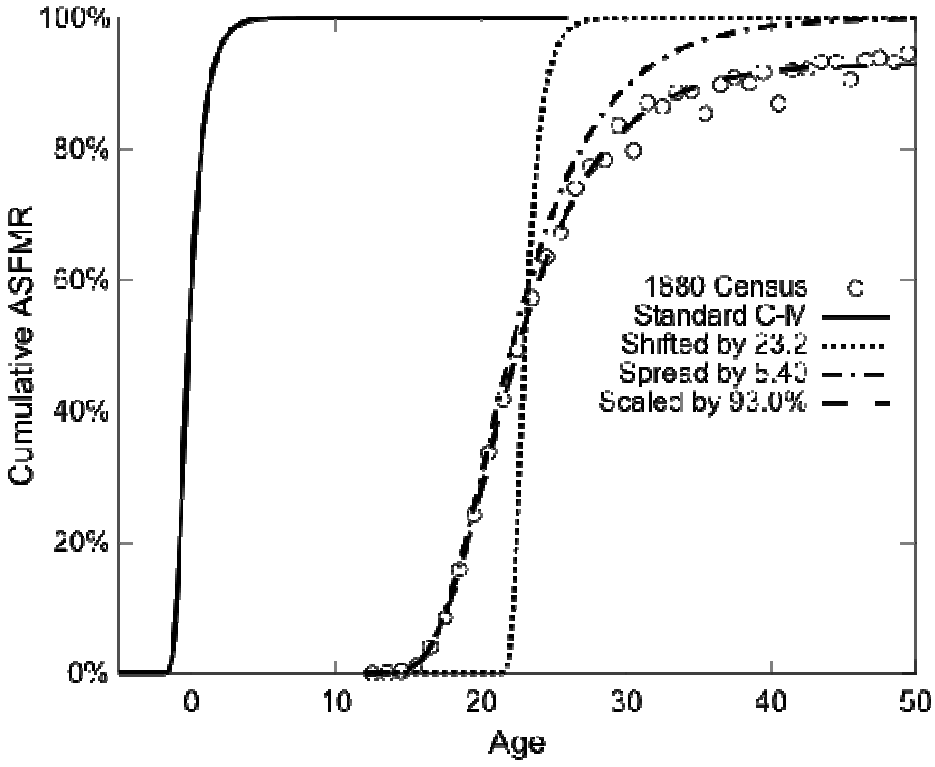

Figure 2: Linearly transforming the Coale- McNeil model to fit to 1880 Census marriage rates by shifting to a mean of 23.2, spreading by a standard deviation of 5.40, and scaling by a TMR of 93.0%.

Thus far, the statistical methods employed have been independent of population age structure. The 19th century was characterized by a combination of low life expectancy

and high birth rates[22]. This means that, on average, each successive birth cohort was much larger than its predecessor as can be seen for the 1880 Census in fig. 1. The raw population counts have been fitted to a curve[23] to smooth over age reporting irregularities such as clustering around multiples of 5 and 10. An inference from fig. 2 is that single women were more likely report a younger age than their married counterparts.

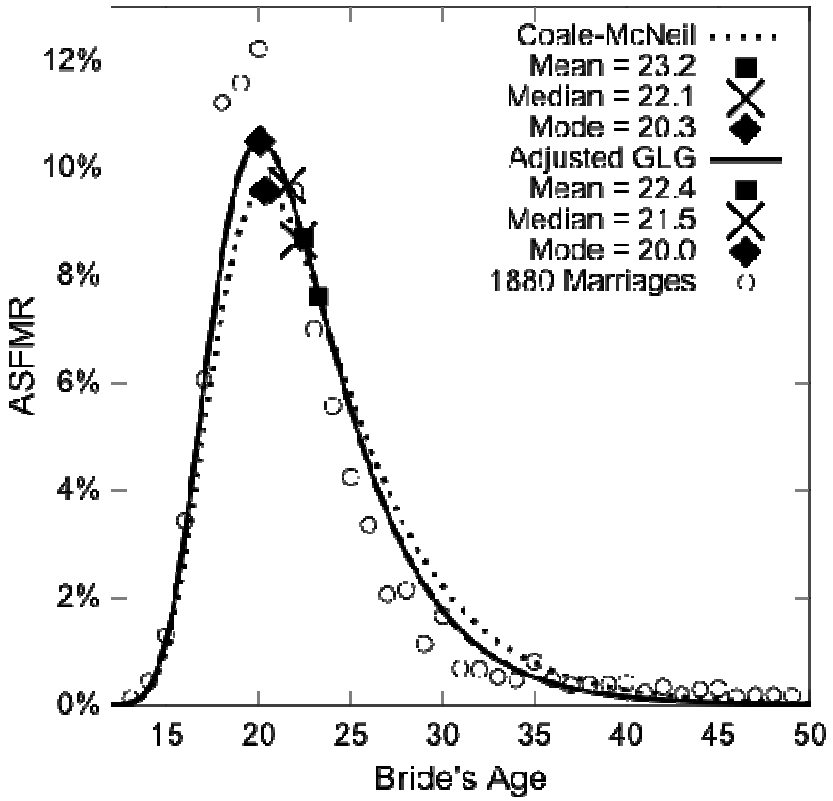

Figure 3: The frequency distribution of 1880 marriages by age. Here the unscaled Coale-McNeil curve is the same as presented in its cumulative form in fig. 1. The adjusted GLG curve is age dependent to more adequately model marriage market dynamics. An age breakdown using 1880 IPUMS "marrinyr" variable shows that even after the adjustment, teenage marriages may be underestimated.

The population curve can be used to weight ASFMRs at younger ages more prominently. The last step in converting from age dependent to age independent statistics

[22]] Michael R. Haines, "The White Population of the United States, 1790-1920." in *A Population History of North America*, edited by M.R. Haines and R.H. Steckel. New York: Cambridge University Press. (2000) p. 305-70.
[23] See Technical Note 7.

is fit the modified ASFMRs to a more general form of the Coale-McNeil equation. As developed by Kaneko[24], the generalized log gamma (GLG) curve employs a 4th parameter that determines the shape or amount of skew. This adjustment corrects much of the remaining bias between Census and county records. However, as will be seen, it is not always possible to detect and remove remarriages from county records to obtain an optimal match.

We are now equipped to answer the question: of all the marriages in 1880 involving first time brides, what percentage were teenagers? The 34.2% obtained from the method can be cross checked with a second source of data from the 1880 Census sample. Census recorders sometimes checked a column for couples who had been married within the last year, but they did not yet specify if the bride had previously been married or not[25]. Of the 9603 white newlywed women under age 50, 40.2% were teenagers. The frequency distribution of this second data set is included in fig. 3.

The method used to obtain age dependent marriage statistics for 1880 can be extended with little complication for subsequent US Censuses as seen in fig. 4 below. After 1940, tracking the minimum age was no longer as crucial so the GLG model was used to obtain a tighter initial fit to the raw synthetic birth cohort data. No attempt was made analyze the fire-destroyed 1890 Census, though summary marriage statistics exist.

From 1850 to1880, IPUMS provides a pair of variables[26] identifying probable wives and mothers based on household dynamics[27] that can be combined to impute

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[24] Ryuichi Kaneko, "Elaboration of the Coale-McNeil nuptiality model as the generalized log gamma distribution," *Demographic Research*, 9:10 (2003):223-262.
[25] See Technical Note 8.
[26] Catherine A. Fitch, *Transitions to Marriage in the United States, 1850-2000*. Unpublished Ph. D. Dissertation, University of Minnesota, 2005.
[27] Steven Ruggles, "Family interrelationships." *Historical Methods* 28:1 (1995):52–58.

marital status. Hacker[28] computed 1880 ratios between imputed and actual marital status to be used as age specific correction factors for 1850-1870. Except at marriage age extremes these correction factors vary between 1.0 and 1.05. Widows with no children in their household are incorrectly imputed as being ever-single and a young bride living with her father-in-law might also be missed. However, a disproportionate number of young mothers were actually not married at ages below 15.

Census data for 1800-1840 does not contain any information on marital status and only a course population breakdown by age. However the Coale-McNeil model for these years can still be estimated after making 3 reasonable assumptions.

1. The Total Marriage Rate is constant at 93%.
2. The minimum age of eligibility is held constant at 1850-1880 average mark of 13.6 years.
3. The mean age (SMAM) decreases linearly from its 1850 mark to 21.0 in 1800.

The first two assumptions are robust given the low variance observed for the 2nd half of the 19th century TMRs and minimum ages[29]. The third assumption follows from a compromise of high and low estimates of the 1800 mean age of expert opinion noted above.

Figure 4 shows long term trends for white teenage brides as a percentage of census year marriage cohorts. Teenage marriage was over four times more common in Joseph Smith's America than it is today. The 1960 baby boom offers a close comparison, but nuptiality has been in rapid decline since. Modern factors contributing to this decline are outside the scope of this paper, but it is easy to see why criticism of the ages involved

[28] J. David Hacker, "Rethinking the 'Early' Decline of Marital Fertility in the United States" *Demography*, Vol. 40, No. 4 (Nov. 2003), pp. 605-620

[29] See Technical Note 9.

in Joseph's marriages has only gained traction recently. Average age differences between husband and wife have also changed dramatically since the mid 19 century. Using IPUMS data, Rolf and Ferrie[30] charted the fall of the age gap from 4.55 years in 1850 to 2.30 years in 2000 after peaking at 4.96 in 1870. They also found the western frontier had an average gap that was two years higher than elsewhere between 1850 and 1880.

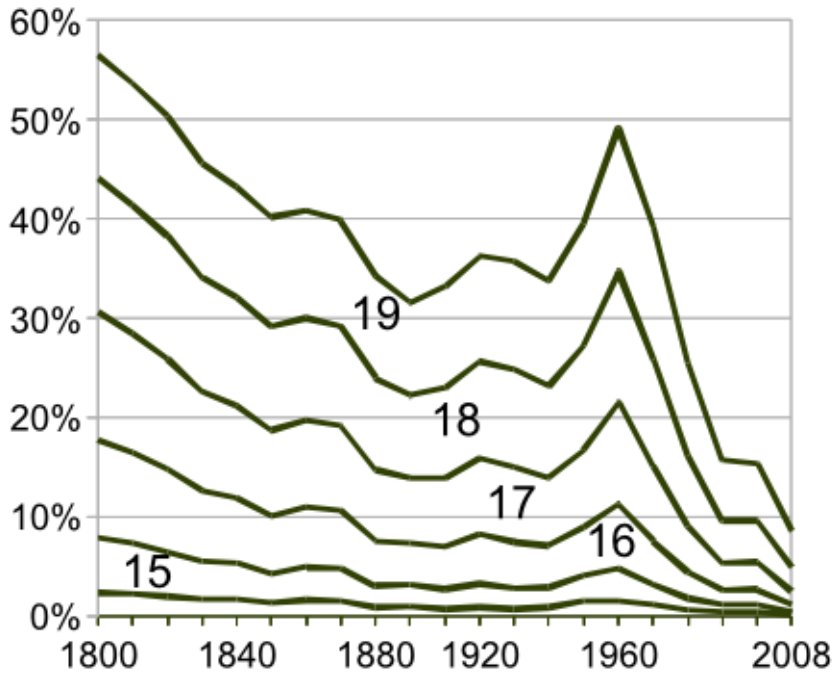

Figure 4: Long term cumulative age dependent ASFMRs. Compare the high teenage marriage rates during the Baby Boom of 1960s and the first half of the 19th century to the low rates in 1880 and 2007.

In the 19th century teenage brides very seldomly married someone near their own age. The average age gap for the mid-teens was typically 2-3 years higher than the overall average. Typically men would court across the entire eligible age spectrum younger than themselves and the economic stability of older men could make them competitive. Higher

[30] Karen Rolf and Joseph Ferrie, "The May-December relationship since 1850: Age homogamy in the U.S." Working Paper (September, 2008).

male to female sex ratios — due to a higher male birth rates and life expectancy as well as immigration[31] — led to the larger age gaps observed in the 19th century.

Table 3 compares Joseph Smith's plural marriages to various regions of the country to the marriages of his peers (aged 34-38) in the 1880 Census sample. While on average Joseph Smith married older women than his 1880 peers, his wives' ages were

	Table 3: Age gap for husbands aged 34-38 using 1880 IPUMS				
Place	**States**	**N**	**mean**	**std**	**Teen %**
Joseph Smith	OH IL MO	33	6.7	12.5	30%
USA		512	10.0	6.5	19%
New England	NH ME VT CT MA RI	39	7.1	7.7	9%
Mid Atlantic	NY PA NJ	72	8.1	5.9	7%
NE Central	OH MI IN WI IL	118	9.4	5.3	10%
NW Central	MN IA MO ND SD NE KS	70	10.9	5.9	20%
S. Atlantic	DE MD VA NC SC GA FL WV DC	75	10.2	5.6	18%
SE Central	AL MS TN KY	60	11.2	6.4	22%
SW Central	OK AR LA TX	62	12.0	6.8	46%
West	AZ CO ID UT NM MT WY NV OR WA CA HI AK	20	14.3	5.8	55%

more spread out. Though his percentage of teenage brides (30%) was slightly higher than a reasonable estimate for his peers in 1840s Illinois (20%), it was far from being historically high. One might wonder if America could have met its manifest destiny without adapting marital practices on the frontier.

Hacker[32] performed a regional breakdown of nuptiality in 1860 using his set of course, national correction factors from 1880. Below we do the same, but modulate national yearly factors by a course, regional factor. Table 4 contains regional statistics for

[31] Albert Esteve and Anna Cabré, "Marriage Squeeze and Changes in Family Formation: Historical Comparative Evidence in Spain, France, and United States in the XXth Century," Paper presented at Population Association of America 2004 Annual Meeting.

[32] J. David Hacker, "Economic, Demographic, and Anthropometric Correlates of First Marriage in the Mid-Nineteenth-Century United States" *Social Science History* 32:3 (Fall 2008):307-345

1850-1880 including the age independent mean and minimum age estimated by fitting the Coale-McNeil model. The tabulated cumulative ASFMRs for 14 year olds have been adjusted to be age dependent. Some entries are left blank or calculated over an extended period as sample size dictates. For the entries based on the smallest sample sizes, we have reported the standard deviation of the margin of error.

Table 4: Regional Marriage Activity

	Age Ind. Mean				**Minimum Age**				**Age Dep. ASFMR for 14**			
	1850	**1860**	**1870**	**1880**	**1850**	**1860**	**1870**	**1880**	**1850**	**1860**	**1870**	**1880**
New England	24.4	23.8	24.4	25.0	13.5	13.8	14.0	14.2	1.0%	0.8%	0.7%	0.4%
Mid Atlantic	23.6	23.5	23.5	24.2	13.7	13.7	13.9	14.6	1.0%	1.0%	0.8%	0.3%
Northeast	***23.8***	***23.6***	***23.8***	***24.5***	***13.7***	***13.7***	***13.8***	***14.5***	***1.0%***	***0.9%***	***0.8%***	***0.3%***
E-North Cen	21.9	22.0	22.5	23.3	13.8	13.6	14.1	14.4	1.3%	1.6%	0.8%	0.4%
W-North Cen	21.1	21.2	21.7	22.4	13.7	14.0	13.8	14.2	1.9%	1.2%	1.4%	0.7%
Midwest	***21.8***	***21.9***	***22.3***	***23.0***	***13.8***	***13.7***	***14.0***	***14.3***	***1.5%***	***1.6%***	***1.0%***	***0.5%***
South Atlantic	22.3	22.4	22.6	22.9	13.5	13.3	13.5	13.5	1.7%	2.2%	1.6%	1.4%
E-South Cen	22.0	21.9	22.6	22.2	13.1	13.4	13.5	13.3	3.2%	2.1%	1.8%	2.1%
W-South Cen	20.8±.3			20.8	13.1±0.2			13.3	3.9±0.9%			2.7%
South	***22.0***	***21.9***	***22.4***	***22.2***	***13.3***	***13.3***	***13.3***	***13.3***	***2.5%***	***2.3%***	***2.1%***	***2.0%***
Mountain	------			20.6	------			13.2	------			3.2%
Pacific	------			22.7	------			13.9	------			0.9%
West	***19.0±0.5***			***21.9***	***13.4±0.3***			***13.5***	**4.6±1.8%**			***1.9%***
USA	***22.7***	***22.5***	***22.7***	***23.2***	***13.5***	***13.5***	***13.7***	***13.9***	***1.5%***	***1.6%***	***1.3%***	***0.9%***

Table 4 shows some interesting trends for the Midwest region. In 1880 the Midwest delayed early marriage almost as much as the Northeast did but soon caught up to nuptial schedule of the United States as a whole. Moving backwards in time we start to see the Midwest morph towards the younger marriage rates found on the frontier. In 1850 the mean marital age in the Midwest was almost a year below the national average. While still above the national average, the 1850 Midwest minimum age was a half year below its 1880 level. Despite the higher minimum, the cumulative marriage rates for 14 year olds in the Midwest had caught up to the US at 1.5% in 1850.

The large number of households in the 10% 1880 census sample can help answer some questions about 19th century factors affecting early nuptiality in the Midwest. We will do some unsophisticated, single variable breakdowns and draw some tentative conclusions. Firstly, does the having more available land lower female marriage ages? IPUMS classifies ¾ of the 1880 Midwest's marriage aged population as "rural." Marriage for female residents (min = 14.2, mean = 22.5) of rural areas where more land was available occurred substantially earlier than their urban counterparts (15.0, 24.3).

The Northeast consistently had the lowest nuptiality in the country throughout the 19th century. Most of the land there had long been settled and migrants looked westward for new economic opportunities. Did the migrants to the Midwest retain the marital culture of their birthplace or do they adapt quickly to the Midwest marriage market? The marriage patterns of the Northeast migrants (14.0, 23.1) highly resembled that of Midwest natives (14.3, 22.9), sharply deviating with Northeast patterns (14.5, 24.5). In contrast, migrants from the South (13.8, 22.1) did marry significantly younger than the natives and preserved all but earliest part of the Southern schedule (13.3, 22.2).

From this limited information, it would appear that statistics from the Northeast where Joseph Smith was born and raised are irrelevant to his marriages in Illinois in the 1840s. The Midwest is split into an eastern and western division by the census bureau, with Illinois assigned to the more populous eastern division. In settling Nauvoo and its surroundings, Latter-day Saints straddled the divisional boundary in Illinois and Iowa. The two areas that the Saints had recently lived in, Ohio and Missouri, were also the most populated states in their respective divisions.

By 1880, Illinois had gained a substantial population with a marriage pattern (14.5, 23.3) typical of the eastern Midwest (14.4, 23.3). In 1850, Illinois had a marital statistics (13.8, 21.6) that took on intermediate values between the western (13.7, 21.1) and eastern division (13.8, 21.9). As sample sizes are relatively small for Illinois, we combined it with its neighboring states (IA, MO, KY, IN, WI, MI) and obtained even lower results (13.6, 21.5).

Our national assumptions stated earlier amount to the mean age rising almost 0.4 years per decade between 1800 and 1850. The data from 1850 to 1880 shows that Illinois mean age was rising more rapidly than that of the US. Thus it conservative to use the national trend to estimate the 1840 Illinois mean as 21.2 years. The regional trend for Illinois to be more similar to the eastern Midwest division the further one goes back suggests dropping the minimum age to 13.7. Under these projections the 1840 Illinois marriage cohort consisted of the following cumulative percentage of teens: 14 (1.9%). 15 (6.7%), 16 (15.6%), 17 (27.4%), 18 (40.3%), and 19 (52.6%).

The 1910 US Census was the first to include information about remarriage. About 12% of white brides under age 50 in the previous marriage year cohort were starting a second (or higher) marriage. Removing these brides lowers the mean age by over a year and matches the cumulative ASFMRs found from adjusting synthetic birth year cohorts. Very few teenagers had adequate time to first be married, then be divorced or widowed, then go through a mourning period, and also court and marry a second husband.

While age structure dependent, county records have their own sources of bias due to the difficulty of identifying remarriages. Figure 5 contains marriage rates of 5 randomly selected counties (4 from Illinois or Iowa and one from late frontier

Nebraska[33]). We attempted to cross check marriage pairs in genealogical databases to eliminate higher order marriages, but much less than the expected 12% were removed before charting. This inadequacy, coupled with smaller sample sizes and local variations, is largely why county marriage rates sometimes trail the Illinois estimates for the 1850 and 1880 marriage cohort also depicted.

The two Mormon data sets likely overlap somewhat, but the selection criteria go to different extremes. For the Nauvoo (1839-1845) set, all marriages with adequate dating information from a compilation by Susan Easton Black[34] were used, while Skolnick78 (1835-1845) includes only once-married couples[35]. Marriage rates from the latter were estimated from the published mean (21.35), standard deviation (4.26), and knowledge gained from 1910 about how the GLG shaping parameter changes when only once-marrieds are considered.

From table 4 and fig. 5 it is easy to find areas of the country for which the frequency of Joseph's teenage wives by age falls below contemporary marriage cohorts. In comparison with the realistic estimation for 1840 Illinois, only Joseph's rate for 14 year olds (6.1% vs. 1.94%) is higher, but not so much so that it is abnormal. Although

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[33] Joyce S. Cowles and Karen Kester, *Lee County, Iowa Marriages* v. 1 (Des Moines: Iowa Genealogical Society, 1987).
"Louisa County [Iowa] Marriages," 1842-1852, <http://iagenweb.org/louisa/LCmarriagepage.htm>
Eileen Gochanour, "Sangamon County, Illinois Marriage Applications - March 16, 1879 thru December 31, 1881,"< http://sangamon.ilgenweb.net/marr1879.htm>
"Cass County [Iowa] Marriages," 1853-1881, <http://iagenweb.org/cass/bmd/mar-1853-1881.htm>
"Hitchcock County [Nebraska] Marriages, Courthouse records starting 26 Jan 1888," 1888-1898 <http://www.usgennet.org/usa/ne/county/hitchcock/olres/marr1888.html>

[34] Susan Easton Black, "Marriages in the Nauvoo Region 1839-1845," on-line database, using sources: Lyndon W. Cook, *Civil Marriages in Nauvoo and some outlying areas (1839-1845)* (Liberty Publishing Co., 1980); with additional data from *Times and Seasons, The Wasp, Nauvoo Neighbor,* and "A Record of Marriages in the City of Nauvoo," located at the Historical Department of The Church of Jesus Christ of Latter-day Saints. <http://www.worldvitalrecords.com/indexinfo.aspx?ix=usa_il_nauvoo_marriages>

[35] M. Skolnick, L. Bean, D. May, V. Arbon, K. De Nevers and P. Cartwright, "Mormon Demographic History I. Nuptiality and Fertility of Once-Married Couples," *Populations Studies* 32 (1978): 14.

tests for normalcy are somewhat arbitrary, we will adopt a tough standard of a 95% critical region. Suppose we were to randomly select a group of 33 brides based on 1840 Illinois ASFMR statistics. We could repeat that processes until a large ensemble of such groups was generated. We wish to determine the expected percentage of those groups contains at least 2 14 year old young women. If Joseph Smith's cohort puts him in the top or bottom 2.5% (approximately 2 standard deviations from the mean in a normal distribution), then we would conclude his behavior was abnormal.

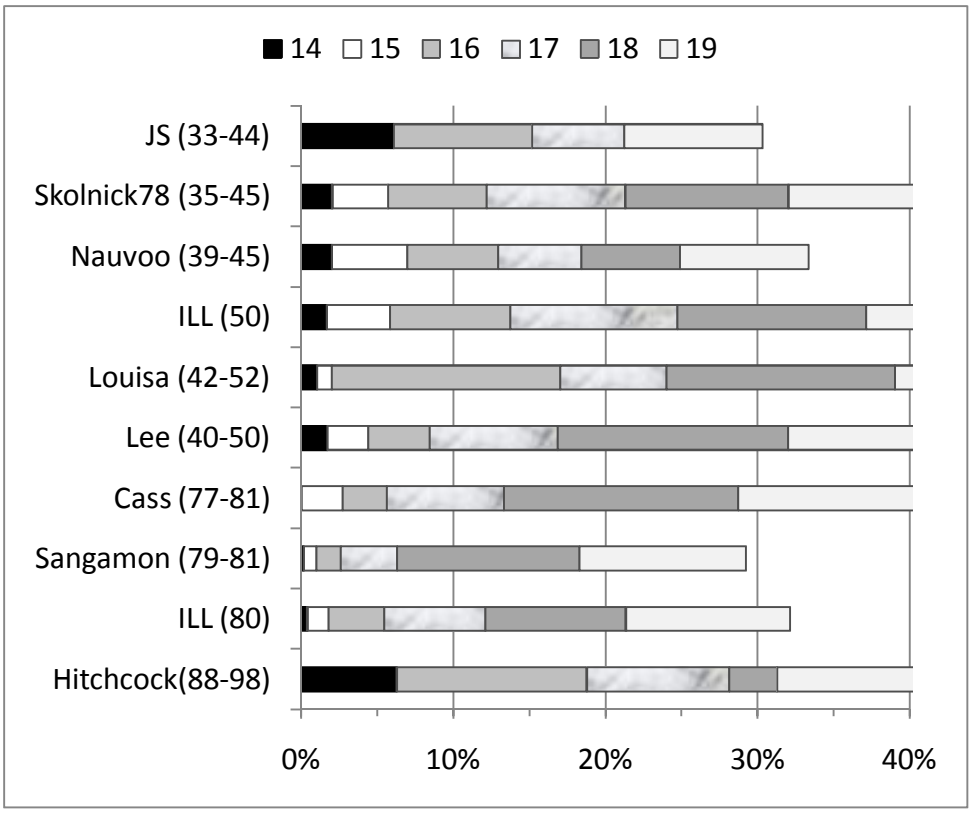

Figure 5: Teenage marriage rates for 5 randomly selected counties, Joseph Smith's plural wives, 2 Mormon data sets, and the Illinois census.

Since Joseph's profile only ranks in the upper 87 percentile[36] for 14 year olds, it is not statistically significant. The high cumulative rate can be adequately explained by the small (N = 33) sample size. At the 95% benchmark, Joseph Smith's cohort would be normal for any region with a cumulative rate at 0.75% for 14 year olds. Plural marriage aside, Joseph Smith would have been normal in any of the four major areas of the US (Northeast, Midwest, South, West) until as late as 1880. Nationally, marriage at 14 years of age did not become that rare until 1980.

Technical Notes

1. Cohorts are arranged by segmenting the population into groups (usually by birth year) and then observing events in each individual's life history. A synthetic cohort can be used to approximate these life histories if the conditions found in a calendar year are assumed to remain constant over time. For example, the 1865 birth cohort in the 1880 Census would synthetically have the same marriage statistics in 1881 as the 1864 birth cohort did in 1880, and so on. See Fitch (2005) p. 28-39 for more information about using synthetic birth cohorts.

2. Expressed as a probability density function, the Coale-McNeil equation is $f(x) = \frac{1.2813c}{\sigma} \exp\left[-1.145\left(\frac{x-\mu}{\sigma}+.805\right) - \exp\left(-1.896\left(\frac{x-\mu}{\sigma}+.805\right)\right)\right]$. Here $f(x)$ gives the instantaneous ASFMR at exact age x with μ as the mean, σ as the standard deviation, and c as the Total Marriage Rate (TMR). The cumulative ASFMR, $F(x)$, can be interpolated from the integral of $f(x)$ once these latter three parameters have been estimated.

3. Demographers often use 5 year intervals to divide cohorts rather than use yearly intervals. Let $\overline{F_y}(x)$ be the observed marriage rate of the total population in the $x \pm \frac{y}{2}$ interval, then TMR can be approximated by $c \approx \overline{F_{10}}(50) \approx \frac{\overline{F_5}(47.5)+\overline{F_5}(52.5)}{2}$.

4. The mean is typically approximated by the Singulate Mean Age at Marriage (SMAM) using Hajnal's method $\mu = 50 - \frac{5}{c}\sum_{i=0}^{6}\overline{F_5}(17.5+5i)$. A convenient way to calculate SMAM is to download the spreadsheet at www.africandemographics.com/files/SMAM.xls and pasting in the percent single for each 5 year age cohort from 15-19 to 50-54.

5. In the Coale-McNeil model, the minimum age at marriage can be approximated from the mean μ and standard deviation σ as $a_0 = \mu - 1.73\sigma$. The standard deviation can be

[36] See Technical Note 10.

calculated by $\sigma = \sqrt{2500 - \mu^2 - \frac{2}{c}\sum_{x=12.5}^{49.5} x\bar{F}_1(x)}$, but it will give inaccurate results with noisy census data.

6. Although the above formulas may suffice for an initial approximation of the Coale-McNeil parameters, optimal matching such as seen in Figure 1 can be done using the maximum log-likelihood estimation criteria derived in Kaneko (2003).

$$\min_{\theta=\{c,\mu,\sigma\}} \sum_{x=x_0}^{x_1} -m_x \ln[F(x+1;\theta) - F(x;\theta)] - n \ln[1 - F(x_1+1;\theta)\,]$$

Here x_0 and $x_1 + 1$ are the lowest and highest ages, respectively, desired to be matched. Furthermore, $m_x = \bar{F}_1(x+1) - \bar{F}_1(x)$ and $n = 1 - \bar{F}_1(x_1+1)$. This equation can be minimized by searching over the parameter space using a numerical optimization routine. Best results were obtained by 1) fixing c at the TMR obtained from Hajnal's method, 2) estimating μ based with $x_0 = 12.5$, $x_1 = 30.5$ (20 youngest ages to avoid age heaping and cohort effects), and a fixed value of a_0 and 3) estimating σ based on the 8 youngest ages and a fixed value of μ.

7. The fitted curve is found by minimizing the sum of squared errors between the natural log of the population data and a 4th degree polynomial for ages 12 to 55.

8. These marriages are found through the use of the Marrinyr variable. The effect of removing brides not on their first marriages should actually increase teenage marriage rates. However the recent marriages appear to be undersampled by about 50% with the late teens and early 20s somewhat over-represented. This is not a problem for the 1910 Census data which includes additional information about number of times and years married. A tight fit was found between our method for finding age-dependent ASFMRs and married-in-the-last-year data for 1910. Because of smaller sample sizes and inconsistent results, demographers have generally avoided using Marryinyr data.

9. One challenge to the assumption that the minimum age of eligibility remained constant at 13.6 is the falling average age at menarche in the 19th century. European data indicates a long term linear drop, while US data is much more sparse. Using post-1910 data, Wyshak (1983) determined that the average age at menarche was dropping linearly at 3.2 month/decade with a value of 13.1 in 1920. This trend projects to 15.2 in 1840 and 16.3 in 1800. The onset of menarche follows a normal distribution that had a larger spread in the 19th century ($\sigma \approx 1.7$ to 2.0) in Brown (1966) and Laslett (1977). At $\sigma \approx 1.85$ and the above projections 19% of females in 1840 reached the minimum age of eligibility while only 7% did in 1800.

10. The percentile (P) of randomly selected marriage cohorts of size N=33 follows a binomial distribution. For 2 14 year olds in 1840 Illinois, p = 1.94% and $P = \sum_{n=0}^{1} \binom{33}{n} p^n (1-p)^n$.