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Marriage dynamics in old Lower California: ecological constraints and reproductive value in an arid peninsular frontier

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ABSTRACT

It is commonly expected that natural selection will favor earlier reproduction, yet ecological constraints can force people to delay marriage. Furthermore, humans demonstrate sex-specific preferences in marriage partners – with grooms normally a few years older than their brides; however, the age at which individuals marry can influence the spousal age gap. We investigate factors influencing age at first marriage and age difference at marriage using nineteenth-century historical demographic data from Baja California Sur, Mexico. Analyses suggest ecological constraints affected male, but not female, age at first marriage. Males who migrated from their natal community and who married in communities whose primary economic activity was agriculture experienced delayed age at first marriage. The age at which females first married increased over time causing a reduction in the age gap between spouses. Furthermore, the spousal age gap showed sex-specific effects: women who married early in life were much younger than their husbands, while women who married later in life were older than their husbands, suggesting that variation in female reproductive value influenced mate choice. Males, on the other hand, who married later in life showed a preference for marrying much younger females, indicating preferences for females with high reproductive value.

Introduction

Marriage is an almost universal feature of the human experience and warrants examination not only because of its linkages to the timing of childbearing and family size (Wachter, Hammel, and Laslett 1978) but also because the age at which men and women marry has implications for the organization of family life, gender relationships, and social change (Malhorta 1997; Mensch, Singh, and Casterline 2005). When researchers do examine the timing of marriage, they almost exclusively focus on women (e.g. Coale 1971) either because...
of demographic implications or because the timing of marriage articulates with larger international concerns about human rights in the context of child marriage and female reproductive health and empowerment (Westhoff 2003). However, examining gender differences in marital dynamics provides insight not only to gender roles and changing societal expectations (Malhorta 1997) but also to questions concerning human evolutionary biology and reproductive ecology.

Natural selection is commonly argued to favor early ages at first reproduction; however, the onset of reproduction is highly variable both across and within animal species and human societies (Charnov 1993). This is due to at least two factors. First, extrinsic mortality is expected to be negatively associated with age at reproduction. Specifically, when the risk of mortality is high, delaying reproduction increases the probability that an organism will not survive to reproduce in the future (Borgerhoff Mulder 1992). Second, reproductive timing and pace translates into one’s proportional genetic contribution to subsequent generations (Borgerhoff Mulder 1992). Thus, in order for natural selection to favor delayed reproduction, the cost to delay must be offset by future gains in survivorship and/or reproduction (Charnov 1993). Human ages at first reproduction vary cross-culturally, but are typically highest amongst societies that have low mortality rates, developed labor markets, and undergone the demographic transition (Kaplan 1994, 1996).

However, empirical analyses demonstrate that pre-industrial societies show evidence of highly variable ages at first marriage and resultant reproductive outcomes. While some studies demonstrate that marriage is generally initiated early (i.e. between 12 and 17 years) for both females and males (Apostolou 2010), other sources show that age at first marriage can occur quite late (e.g. late 20s) or not at all (e.g. Hajnal 1965, 1982; Strassman and Clarke 1998; Voland 1995). Ecological constraints (which can be partitioned into biophysical, cultural, and demographic domains) may be responsible for delayed onset of first marriage in pre-industrial contexts (Hajnal 1965; Kramer, Schacht, and Bell 2017; Lesthaeghe 1980; Strassman and Clarke 1998). Individuals may delay reproduction if the costs of initiating a family are high (Strassman and Clarke 1998). This is particularly likely in agricultural societies with low biological productivity, fertile land shortages, and/or cultural rules prescribing neolocality – a residence rule stating that after marriage, couples should reside in a unique, economically independent household (Hajnal 1965, 1982; Low 1991; Strassman and Clarke 1998; Voland and Dunbar 1997). Furthermore, in small populations, stochastic forces (such as birth and death rates) can alter the adult sex ratio in ways that make finding a marriage partner difficult, forcing individuals to either delay marriage or migrate (Kramer, Schacht, and Bell 2017). Dispersal is typically a costly behavior, resulting in loss of body mass and elevating stress in social mammals, generally (Maag et al. 2019), as well as delaying the age at first marriage in pre-industrial societies (Carlson 1985; Voland and Dunbar 1997).

The age gap between spouses is another useful metric for assessing both socio-cultural dynamics and evolutionary hypotheses (Low 1993; Voland and Engel 1990). Spousal age difference at marriage has been used as an index to assess the relative social autonomy of females (Atkinson and Glass 1985; Esteve, Cortina, and Cabré 2009), as well as the degree of sexual selection within human populations (Voland 1995). Although a number of factors have the potential to affect the age gap between spouses (e.g. the availability of mates), humanists typically argue that smaller age differences indicate greater equality in gender relationships (Atkinson and Glass 1985; Esteve, Cortina, and Cabré 2009) while
evolutionary demographers typically argue that larger age differences represent stronger female preferences for socially successful males (Pollet and Nettle 2008; Voland 1995; Voland and Engel 1990). Evolutionary psychological and cross-cultural analyses generally show that males prefer younger females as spouses, while females prefer older males (Buss 1989). Because female reproductive value covaries with age, younger women are expected to be more selective about potential mates, resulting in marriages to males who are older and wealthier (Voland 1995); however, these results appear to be heavily conditioned by age at marriage and culture (Otta et al. 1999; Voland 1995).

Accordingly, we seek to test hypotheses about the determinants of the age of first marriage and spousal age difference at marriage using nineteenth-century historical demographic data from Baja California Sur, Mexico. In a presentation of our results upfront, we find that males experienced delayed age at first marriage, while females typically married much younger than their male partners. Over time, however, female age at first marriage increased substantially, thereby causing a decrease in the difference in the age at marriage. Consistent with the ecological constraints model, males’ (but not females’) age at first marriage increased if they migrated into new communities and if they resided in a community whose economic focus was agriculture. Last, spousal age difference at marriage showed sex-specific effects. For males, the spousal age gap increased as male age at first marriage increased and if they married in communities reliant on mining. For females, the spousal age gap decreased as age at first marriage increased. We situate our results within a biocultural framework.

Materials and Methods

Study Site

Baja California Sur, Mexico is one of the two Mexican states that comprises the Baja California peninsula. Currently, Baja California Sur is one of the least inhabited areas of Mexico, and along with its northern neighbor (Baja California) are colloquially known as, “the Forgotten Peninsula” (Krutch 1986) or “the Other Mexico” (Jordan 1951). This designation is partly due to the unique, regional history of the peninsula where its geographic remoteness and harsh arid climate led to its limited integration into the Mexican nation-state until the late-nineteenth and early-twentieth centuries. Although inhabited by indigenous peoples for millennia (Des Lauriers et al. 2017; Fujita 1995; Macfarlan and Henrickson 2010; Molto and Fujita 1995), permanent habitation by peoples of Euro-American descent only began in 1697 AD following the settlement of Loreto by Jesuit priests (Englehardt 1908; Martinez 1960). After 70 years of mission building and tight administrative control over the exploitation of the peninsula, the Jesuits were expelled in 1768 AD (Crosby 1994). This event marked a second wave of migration of colonists from New Spain to the peninsula. Many of the modern family names that comprise the peninsula today emanate from these two initial periods of colonization (Martinez 1965).

Following independence from Spain, the Baja California peninsula officially declared allegiance to Mexico in 1821 AD (Martinez 1960). This initiated a third wave of migration, largely from mainland Mexico (primarily from the states of Sonora and Sinaloa), after attempts were made by the central Mexican government to open the peninsula for
economic exploitation through secularization of church lands (Gerhard 1953). The political vacuum left by the removal of the Spanish crown, political turnover in Mexico City, and an overextended Mexican government initiated an era of considerable inter-community conflict led by charismatic strongmen (known as, “caudillos”) seeking political and economic power in the Baja California peninsula that lasted until nearly 1890 AD (Martinez 1960). However, during the nearly 70-year period between independence and politico-economic integration into the larger Mexican nation, the Baja California peninsula experienced a variety of disruptive external influences, including (1) the Mexican–American War (1846–1848 AD) – which nearly saw the peninsula annexed to the US (Amero 1984; Chamberlin 1963; Gerhard 1945; Yates and Halleck 1975), (2) the invasion of American filibuster William Walker (1853 AD) who sought to establish a slave state, the Republic of Sonora (Cleland 1944; Wyllys 1933), (3) the French invasion and establishment of the Second Mexican Empire (1863–1867 AD); and (4) the Porfiriato Period (1875–1910 AD), where the Baja California peninsula experienced a period of modernization through foreign investment, with nearly two-thirds of the peninsula under the control of foreign companies (Martinez 1960).

During the Porfiriato, the Baja California peninsula experienced the fourth wave of migration largely from international sources, including (but not limited to) American, French, German, English, Russian, and Chinese sources. Although the peninsula experienced constant in-migration throughout the nineteenth century, the population of the peninsula was sparse. Over a land area of 143,390 square kilometers, the total population in 1812 AD has been estimated at 2,938 people, by 1850 AD, 7,921, and by 1900 AD, 47,624 (SFCI 1905; Trejo Barajas 1994, 2005). In Baja California Sur, these population values were 1,690, 6,575, and 40,041 across the three time periods, respectively (SFCI 1905; Trejo Barajas 2005).

During the nineteenth century, the Baja California peninsula saw the development of a distinct regional culture shaped by its sparse population, history of political instability, as well as by its physical environment (Crosby 1981). As a largely hot, arid, desert with minimal surficial freshwater stocks (Kottek et al. 2006; Rebman and Roberts 2012), communities grew either near ocean ports (such as the towns of Loreto, La Paz, Mulegé, and San Jose del Cabo) or next to the only permanent source of freshwater that exists on the peninsula, aridland springs (typified by communities such as San Ignacio, Comondú, Todos Santos, and Santiago) (Crosby 1994; Martinez 1960). Households were largely self-sufficient and engaged in cattle and goat ranching and/or subsistence agriculture; however, due to a dearth of arable land and freshwater, establishing new households was a challenge (Crosby 1981). Large-scale extractive mining operations also supported the development of communities, such as Santiago and Santa Rosalía, the latter of which occurred as a result of foreign investment during the Porfiriato (De Novelo 1989).

As a Catholic population, marriage was monogamous and divorce infrequent. Marrying a first cousin was not uncommon (Crosby 1981), but frowned upon by the Church which fined couples for doing so (Martinez 1965). Gender roles were often non-overlapping with women responsible for raising children and domestic duties, while males engaged in economic production outside the home. This pattern of gendered relationships exists today in many of the modern ranching communities found throughout the peninsula (Crosby 1981; Koster et al. 2019); however, it should be noted that power dynamics today are largely gender egalitarian and appear to be driven by household self-sufficiency and cultural isolation. Sources of
extrinsic mortality during the nineteenth century included highly infectious diseases such as smallpox and yellow fever, as well as catastrophic weather events such as hurricanes and prolonged drought (Martinez 1965; Trejo Barajas 1994, 2005; Villanueva 2004).

**Data**

Marriage data were extracted from vital records contained within the *Guía Familiar de Baja California: 1700–1900* (Martinez 1965). This tome contains marriage, birth, baptismal, and/or death records for 13 communities from the Baja California peninsula covering both the modern Mexican states of Baja California (Ensenada and San Francisco de Borja) and Baja California Sur (San Ignacio, Santa Rosalía, Mulegé, Comondú, La Purisima, Loreto, La Paz, Todos Santos, San Antonio, Santiago, and San Jose del Cabo). The data contained with the text were obtained by Pablo Martinez, who during the 1950s and hand transcribed ecclesiastical records from Jesuit, Franciscan, and Dominican missions, as well as parish records and governmental archives (Martinez 1965). Due to deterioration related to natural causes and human carelessness, portions of the original source materials were not capable of being transcribed. As a result, Martinez’s efforts provide a partial picture of the population dynamics on the peninsula during this period. However, there is little reason to believe that data deterioration was biased in any particular direction, thus leaving a representative sample of marriage records across these communities. Furthermore, because systematic censes were not employed in this region of the world until 1895 AD (Platt 1998), this data represents the only source material for reconstructing marriage patterns on the Baja California peninsula prior to the twentieth century. Because the data source lacks information on those who never married we target the age at marriage and the spousal age gap only for those who did marry.

For the sake of data comparability, we restricted our analyses to the state of Baja California Sur (BCS). However, not every community within BCS contained marriage records. As such, our analyses include eight communities: Santa Rosalía, Comondú, Loreto, La Paz, Mulegé, Todos Santos, San Antonio, and San Jose del Cabo (Figure 1). Two had economies focused on mining (Santa Rosalía and San Antonio) and the rest were focused on agriculture and ranching (Trejo Barajas and González Cruz 2002). One thousand, six hundred and twenty-two marriage records were extracted spanning 1809–1900 AD (Figures 2 and 3). Records contained a variety of information including (1) the first and last names of the marrying couple, (2) their ages at marriage, (3) whether each individual had been married previously, and (4) the location from where each individual was born (Table 1). From this data, we were able to generate the age difference in marriage. All data are available via the Supplementary File.

**Analysis**

Our analytical models are performed using STATA IC/15 (Rabe-Hesketh and Skrondal 2008). We apply Generalized Estimating Equations (GEE) which allow us to estimate population-averaged effects while accounting for the nested structure of the data (i.e. individuals within communities). Our outcome variables are age at first marriage (a continuous variable) and age difference in first marriage (a continuous variable). We perform analyses by gender and include spouse’s age at marriage (a continuous variable), year of marriage (a continuous variable), natality (a binary variable), and community economic type (a binary variable) as predictor variables and include community (a categorical variable) as a random-effect. All of the GEE
models reported herein employ Gaussian distributions with an identity link-function and an exchangeable correlation structure. We opt for GEE models in lieu of other time-to-event analyses (e.g. survival or hazard analysis) as the data is composed of only those individuals who experienced the event (marriage) and there are no censored observations.

**Results**

**What Explains Age at First Marriage?**

The ecological constraints model suggests that individuals will delay marriage when the cost of establishing an independent household is too high (as is found in biologically
unproductive, land-limited, agricultural societies), when population sizes are small (i.e. partners are rare), or when migration occurs (Hajnal 1965, 1982; Strassman and Clarke 1998; Voland 1995). We employ two statistical models, one for males and one for females.

Figure 2. The number of marriage records by community.

Figure 3. The number of marriage records by year.
The outcome variable is the age at first marriage. The independent variables include the year of marriage, community economy, and whether or not the individual married within their natal community. Due to the known statistical correlation between male and female age at marriage (Otta et al. 1999), we include spouse’s age as a covariate in each model. For males, we find that marrying within one’s natal community is associated with a significantly lower age at first marriage (B = −1.8; p = .008) while residing in a community whose principal economy was agriculture was associated with a significantly later age at marriage (B = 1.4; p < .001); however, year of marriage had no effect (B = −0.001; p = .96) (Table 2). For females, we find that age at first marriage significantly increased over time (B = 0.1; p < .001) however, natality (B = 0.9; p = .23) and economy (B = 0.6; p = .61) had no effect (Table 2). In general, male and female age at first marriage was correlated (Figure 4).

What Explains the Spousal Age Gap at First Marriage?

Social and evolutionary scientists argue that the age difference at first marriage is a useful metric for assessing gender relationships and the strength of sexual selection (Esteve, Cortina, and Cabré 2009; Voland 1995). Typically, grooms are older than their brides (Buss 1989); however, this effect should be conditioned by age (Otta et al. 1999) or socio-economic context

### Table 1. Descriptive statistics associated with nineteenth century marriage records from the Baja California peninsula.

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Mean(SD)</th>
<th>Median</th>
<th>Min/Max</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year of Marriage</td>
<td>1621</td>
<td>1875(24)</td>
<td>1882</td>
<td>1809/1900</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Male Previously Married</td>
<td>1376</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>876</td>
</tr>
<tr>
<td>Female Previously Married</td>
<td>921</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>59</td>
<td>862</td>
</tr>
<tr>
<td>Male Age at 1st Marriage</td>
<td>744</td>
<td>28(8)</td>
<td>26</td>
<td>15/74</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Female Age at 1st Marriage</td>
<td>735</td>
<td>21(6)</td>
<td>20</td>
<td>12/55</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Age Difference at 1st Marriage</td>
<td>557</td>
<td>7(7)</td>
<td>6</td>
<td>−20/53</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Male Natal (0 = No; 1 = Yes)</td>
<td>736</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>305</td>
<td>431</td>
</tr>
<tr>
<td>Female Natal (0 = No; 1 = Yes)</td>
<td>655</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>355</td>
<td>300</td>
</tr>
<tr>
<td>Economy (Agriculture = 1; Mining = 0)</td>
<td>581</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>390</td>
<td>191</td>
</tr>
</tbody>
</table>

The outcome variable is the age at first marriage. The independent variables include the year of marriage, community economy, and whether or not the individual married within their natal community. Due to the known statistical correlation between male and female age at marriage (Otta et al. 1999), we include spouse’s age as a covariate in each model. For males, we find that marrying within one’s natal community is associated with a significantly lower age at first marriage (B = −1.8; p = .008) while residing in a community whose principal economy was agriculture was associated with a significantly later age at marriage (B = 1.4; p < .001); however, year of marriage had no effect (B = −0.001; p = .96) (Table 2). For females, we find that age at first marriage significantly increased over time (B = 0.1; p < .001) however, natality (B = 0.9; p = .23) and economy (B = 0.6; p = .61) had no effect (Table 2). In general, male and female age at first marriage was correlated (Figure 4).

### Table 2. GEE model coefficients explaining age at first marriage.

<table>
<thead>
<tr>
<th></th>
<th>B(RSE)</th>
<th>z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Male</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>−0.001(0.01)</td>
<td>−0.1</td>
<td>.96</td>
</tr>
<tr>
<td>Male Natal (0 = No; 1 = Yes)</td>
<td>−1.8(0.7)</td>
<td>−2.7</td>
<td>.008</td>
</tr>
<tr>
<td>Economy (0 = Mining; 1 = Agriculture)</td>
<td>1.4(0.3)</td>
<td>4.3</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Spouse’s Age at Marriage</td>
<td>0.7(0.04)</td>
<td>16.3</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Constant</td>
<td>15.2(23)</td>
<td>0.6</td>
<td>.52</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>0.1(0.02)</td>
<td>4.03</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Female Natal (0 = No; 1 = Yes)</td>
<td>0.9(0.7)</td>
<td>1.2</td>
<td>.23</td>
</tr>
<tr>
<td>Economy (0 = Mining; 1 = Agriculture)</td>
<td>0.6(1.2)</td>
<td>0.5</td>
<td>.61</td>
</tr>
<tr>
<td>Spouse’s Age at Marriage</td>
<td>0.4(0.02)</td>
<td>20.1</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Constant</td>
<td>−164(43)</td>
<td>−3.8</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

*a* Male model: n-observations = 629; n-groups = 8; Wald $X^2 = 506; p < .0001.

*b* Female model: n-observations = 563; n-groups = 8; Wald $X^2 = 1417.3; p < .0001.
To understand what factors affect spousal age difference, we employ three statistical models. First, we examine a generic model that includes the year of marriage and community economy as independent variables, followed by sex-specific models that include male and female age at first marriage. With respect to the first model, we find that the difference in the age at first marriage significantly decreases over time ($B = -0.03; p = .053$) and that communities engaged in agriculture (as compared to mining) have smaller spousal age gaps ($B = -0.8; p < .001$) (Table 3; Figure 5). The decrease in age difference in marriage over time appears to be driven in part by both a steeper rise in female age at first marriage and a shift in preferences where males find it acceptable to marry women who are older than themselves.

**Table 3.** GEE regression coefficients associated with spousal age gap.

<table>
<thead>
<tr>
<th></th>
<th>B(RSE)</th>
<th>z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Both Sexes$^a$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>$-0.03(0.02)$</td>
<td>$-1.9$</td>
<td>.053</td>
</tr>
<tr>
<td>Economy (Agriculture = 1; Mining = 0)</td>
<td>$-0.7(0.2)$</td>
<td>$-4.6$</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Constant</td>
<td>70(33)</td>
<td>2.2</td>
<td>.031</td>
</tr>
<tr>
<td>Male$^b$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>$-0.05(0.3)$</td>
<td>$-2.2$</td>
<td>.03</td>
</tr>
<tr>
<td>Economy (Agriculture = 1; Mining = 0)</td>
<td>$-2.2(0.4)$</td>
<td>$-5.6$</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Male Age at First Marriage</td>
<td>0.6(0.02)</td>
<td>25.8</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Constant</td>
<td>95(47)</td>
<td>2.01</td>
<td>.04</td>
</tr>
<tr>
<td>Female$^c$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>$-0.01(0.01)$</td>
<td>$-0.9$</td>
<td>.39</td>
</tr>
<tr>
<td>Economy (Agriculture = 1; Mining = 0)</td>
<td>0.4(0.3)</td>
<td>1.3</td>
<td>.21</td>
</tr>
<tr>
<td>Female Age at First Marriage</td>
<td>$-0.3(0.03)$</td>
<td>$-8.8$</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Constant</td>
<td>35(24)</td>
<td>1.5</td>
<td>.15</td>
</tr>
</tbody>
</table>

$^a$Both sex model: n-observations = 556; n-groups = 8; Wald $\chi^2 = 21.2; p < .0001$.

$^b$Male model: n-observations = 556; n-groups = 8; Wald $\chi^2 = 670; p < .0001$.

$^c$Female model: n-observations = 556; n-groups = 8; Wald $\chi^2 = 147.9; p < .0001$.
With respect to our sex-specific models, for males, we find that in addition to year of marriage ($B = -0.05; p = .03$) and community economy effects ($B = -2.2; p < .001$), age at first marriage significantly affected the age difference in marriage ($B = 0.6; p < .001$) (Table 3). Males who first married at older ages typically had larger spousal age gaps compared to those who married at younger ages (Figure 6). For females, we find that age at first marriage fully

**Figure 5.** The spousal age gap over time.

**Figure 6.** The spousal age gap by male and female age at first marriage.
mediated the relationships between spousal age gap, year of marriage, and community economy; however, age at first marriage had a strong negative relationship with the spousal age gap ($B = -0.3; p < .001$) (Table 3; Figure 6). Females who first married later in life tended to be more similar in age to their spouses or even older than their spouses.

**Discussion**

We performed these analyses to understand the factors influencing age at first marriage and spousal age difference at first marriage. Our research is positioned within the growing contingent of historical demographic studies that explicitly employ an evolutionary ecological framework (Voland 2000). Consistent with an ecological constraints model, we find that the male age at first marriage was substantially impacted by both migration and economic activity. However, females did not appear to experience similar ecological constraints. Furthermore, we find that spousal age difference at marriage followed trends predicted by evolutionary demography. On average, males married females younger than themselves; however, age at first marriage affected this relationship. For males, as the age at first marriage increased, so too did the age difference in marriage; however, for females, we found the opposite.

The Baja California peninsula is largely a hot, arid, mountainous landscape with minimal surficial freshwater stocks. The Euro-American colonists who settled this region throughout the nineteenth century brought with them an economic and cultural toolkit that was not well adapted to this particular climate – a preference for agriculture, ranching, and neolocal residence. Flat, arable land in close proximity to freshwater was rare and it appears that, generally, males who attempted to eke a living from agriculture and ranching were forced to delay the onset of marriage until sufficient land or capital was available to start a family. Socio-ecological contexts like this can lead to at least two outcomes: 1) reproductively aged individuals who remain natal as “helpers at the nest” (Davis and Daly 1997; Emlen 1982) or 2) reproductively aged individuals who disperse (Stacey and Lignon 1987). Ethno-historic accounts suggest both were strategies employed by individuals from ranching families. According to Crosby (1981, 130–132), ranching families were usually large, consisting of three or more generations and upward of “fifteen people ranging in age from infancy to dotage, with no intermediate generations omitted” and children being raised in numerous and varied familial company, including siblings, aunts, uncles, grandparents, and even great-grandparents. The low environmental quality put upper-bound limits on these extended family units and appear to have influenced inheritance norms. Crosby (1981, 112) suggests that although a single married couple might have upward of 10 children, a single ranch could only support two to three married couples and their children. As a result, it became normative for the eldest male to inherit the family ranch and indicate the brother or brothers who would remain at the ranch, while the others were forced to start households elsewhere. Prior to complete habitat saturation, these individuals could simply move up or down particular drainages to novel locations where spring water and flat land existed. However, over time, dispersal would require further distances.

Consistent with this perspective, our analyses demonstrate that men who dispersed from their natal areas were at a distinct disadvantage compared to those who did not. Recent research on reproductive patterning on the peninsula offers additional insight...
(Koster et al. 2019). Because of the reliance of livestock production in the region, households are dependent on the care and herding of animals performed by the male heads of households and their sons. Accordingly, parents attempt to keep sons close to allow for mutual aid even after they marry. Thus, given the ‘traditional’ nature of the gender roles with males as household breadwinners, and the social and economic capital available to men in their natal area, men who disperse to marry appear to face costs by way of reproductive delays.

However, when economic opportunities such as mining became available, males were able to initiate marriage at much younger ages. Although males married relatively earlier in mining communities, they appear to have done so with larger age gaps. This may indicate a substantially male-biased sex ratio across the mining communities of Baja California Sur. Such an outcome is not surprising (e.g. Pollet and Nettle 2008; Schacht and Smith 2017), especially for communities like Santa Rosalía, which experienced a mining boom in the late 1880s through the 1900s (De Novelo 1989; Trejo Barajas and González Cruz 2002). Historical records maintained by the El Boleo mining company in Santa Rosalía suggest that the adult population was massively male-biased in 1896 AD (adult males = 2696, adult females = 1538, sex ratio = 1.75); however, the same was not true for children (boys = 755, girls = 739, sex ratio = 1.02) (Gil and Manuel 1989).

Females, but not males, experienced an increase in age at first marriage over time suggesting an increasing difficulty with locating a partner, habitat saturation, and/or changing gender norms related to when females should initiate reproduction. Prior to 1867 AD and outside of a single outlier occurring in 1849 AD (where the bride and groom were 45 and 30 years old, respectively), males exclusively married younger females who were quite young (e.g. <20 years old) at first marriage. Following 1867 AD, a trend emerged where males became increasingly more likely to marry females who were older than themselves. With the onset of the Porfiriató Period (1875 AD), the Baja California peninsula, along with the rest of Mexico, experienced massive in-migration from international sources, including men and women from Europe, Asia, and North and South America. The influx of these women could have rebalanced the marriage market, thereby increasing competition over marriage partners for females and possibly delaying and/or inverting age at marriage as a result. Additionally, given the low carrying capacity of the region, as available habitable areas filled up, no longer was female scarcity an issue but instead, the issue became one of the land scarcity, an interpretation consistent with other work on the topic (Voland and Engel 1990).

One of the limitations of this project is that we only have data on those individuals who married and not for those who never married. This is an unfortunate, but typical, consequence of working with historical data. Although data of this quality may produce biased estimates (Desjardins 1995; Willigan and Lynch 1982), many questions can still be evaluated to give us better insight into the reproductive dynamics of the Baja California peninsula during nineteenth the century. For example, as predicted, age at first marriage was related to the spousal age gap in sex-specific ways (Otta et al. 1999). Women who married earlier in life were typically much younger than their husbands, while females who married later in life were typically much closer in age to their husbands. We interpret this finding as evidence of those with high reproductive value leveraging it to marry those of greater wealth (for which we use age as a proxy), whereas women who first married past their reproductive prime were forced to be less selective over mates. Unfortunately, we lack data on socio-economic status;
however, our findings are consistent with research that shows that wealth, status, and age are correlated in historic populations (e.g. Pollet and Nettle 2008; Voland and Engel 1990). Interestingly, males who married late in life were typically much older than their brides, suggesting that older men were targeting fecund women and that these women and their families were less concerned about age and more about the resources that older men held.

In sum, our research fills a major gap in the historical demography of Baja California Sur, Mexico, in particular, and the Baja California peninsula, more generally. In the absence of high-resolution censuses throughout the nineteenth century (Platt 1998), the demographic history of the Baja California peninsula has largely been understood as simply one of the generic population growth (e.g. Trejo Barajas 1994, 2005). However, through the lens of age at first marriage and spousal age differences, it is possible, if only imperfectly, to understand reproductive dynamics in response to marriage market and ecological constraints in this arid peninsular frontier.

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Disclosure Statement

The authors have no financial interests or benefits to declare with this research.

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