SUPPLEMENTARY INFORMATION

Social Capital

Social capital is a form of economic and cultural capital embedded in social networks that enables people to act collectively. These networks are characterized by reciprocity, cooperation and trust and are seen to play a central role in producing outcomes which increase the common good[1,2]. The term has been in use since the late 19th century but gained considerable traction in the academic literature in the 1990's. Pierre Bourdieu defined social capital as "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance and recognition"[3]. According to Robert Putnam, social capital is a critical component of building and maintaining democratic institutions and can be assessed by measuring the degree of trust and reciprocity within a community[4,5]. Like human-capital theory, which has been used by economists to analyze investments in education and training throughout the life course[6], social capital theory provides a framework for understanding and attempting to quantify the features of social organization (e.g. networks, norms, cultural traditions and shared values) that facilitate coordination and cooperation amongst group members[7].

The boundaries between groups, however, are crucial for understanding these processes and distinctions are often made between 'bonding' and 'bridging' social capital[8]. Bonding social capital refers to the exclusionary social ties that are formed around a shared culture, religion, political belief, socioeconomic status or ethnicity while bridging social capital refers to the horizontal ties between groups that transcend these differences. In diverse societies, bridging social capital is viewed as crucial for developing networks that span homogeneous groups and help to generate society-wide social cohesion, whereas bonding social capital can counteract this process by knitting people into their own isolated and adversarial tribes[4,9–11]. How bridging and bonding social capital affect integration outcomes has been an important area of research. Because the more exclusive ties of bonding social capital are expected to provide some benefits to the immigrant population and the more inclusive ties of bridging social capital are expected to improve overall social cohesion, understanding how to build institutions that enhance both types of social capital is a key challenge of globalization[12]. One of the major threats to the legitimacy of global institutions is the feeling that the 'game is rigged' and that these institutions are designed to benefit particular groups over others. Building bridging or bonding social capital is essentially a problem of collective action and in order to participate and benefit from the global economy, different groups must ultimately figure out ways to build bridging social capital ties[13].

The amount and type of social capital may vary between individuals, however. An analysis of the General Social Survey (GSS) of the United States in 1985, for example, found that the range of social networks — a measure of the extent to which someone comes into contact with a diverse set of others — were highest amongst the young, urban and highly educated while the density of social networks — a measure of the tightness and familiarity of individuals within a network — was higher for individuals living in rural, less densely populated areas[14]. In other words bridging social capital was higher for young, urban elites while bonding social capital was higher for older and less educated individuals and those living in rural areas. There is also evidence in humans that individuals who are better able to maintain ties to their own culture may have better life outcomes and are better able to adapt to social change. For example, cultural continuity and the pace of cultural change have been identified as important factors influencing the risk of suicide amongst First Nations people in Canada[15]. Meanwhile social isolation and the destruction of social networks within Native American populations has been shown to increase mortality and reduce health outcomes[16]. Minority students who maintain stronger bonds with their families, cultures and ethnic enclaves (i.e. high bonding social capital) do better in school than those who are more isolated[17] and the same factors that affect social mobility and social capital among natives, such as parents education or single parent families[18], are also the best predictors of public school dropout rates among immigrant minority students[19]. Furthermore, the age at which someone emigrates can also affect social networks and predict assimilation. A study using microdata from the 2000 US Census found that proficiency in English and arrival at younger ages raised the probability of marrying a native, of having a more educated and higher-earning spouse, of having fewer children and of living outside of ethnic enclaves[20].

The Contact Hypothesis

The contact hypothesis relies on the idea that under appropriate conditions increasing the frequency of interpersonal interactions between members of different groups is one of the most effective ways to reduce prejudice. Allport (1954) argues that prejudice results from generalizations made about a group of people that is essentially based on incomplete information and he outlines specific criteria which should be met in order to reduce these prejudices. The rival groups must have equal status, be interdependent, have common goals, receive government or societal support for cooperating and have frequent and informal personal interactions with outgroup members[21]. A basic assumption of the contact hypothesis is that increased awareness and understanding of groups that are different from us will reduce prejudice[22,23]. Critics of the hypothesis argue that it is overly simplistic and that the nature of the differences between the groups are also important[24].

Relationships between immigrants and members of the host society are complex. A recent meta-analysis has shown that cooperation and conflict between immigrants and hosts depend on a variety of interrelated factors[25] but a few factors seem to stand out. First, egalitarian cultures overall seem to be more tolerant of out-groups[26]. This effect may depend on access to resources, however, and fewer resources has been linked to greater distrust of outsiders and increased in-group solidarity[27–29]. Resources can affect social capital too and a large study of British neighborhoods showed that lower neighborhood socioeconomic status was a better predictor of a reduction in social capital than increasing racial diversity[30]. The size of the immigrant groups (e.g. the perceived threat) may also be important, although this relationship is not necessarily linear and smaller initial increases in immigrant populations often result in more hostility than later and larger increases[31].

Studies on the relationship between immigrant and host communities also depend on what exactly is being measured and important distinctions have been made between economic and social integration. A large study of immigration in Spain, for instance, found that although integration into labor markets was largely impervious to the number of immigrants, social integration — measured as the intermarriage rate between immigrants and the host population— was not. The rate of intermarriages decreased as migrant density increased[32]. The interaction between government policy and economic and cultural conditions can also affect these relationships. A large cross national study tracking indices of trust over time found that, although immigration seemed to have a negative impact on social engagement and overall social trust (e.g. membership in voluntary organizations and involvement in the political process), these relationships vary in broadly predictable ways. In more economically equal countries and countries where minority groups are recognized and accommodated, for example, these negative effects are often mitigated and, in some cases, completely reversed[33]. Finally, an implicit assumption of the contact hypothesis is that bonding and bridging social capital are inversely correlated such that hostility and prejudice towards out-groups is positively associated with stronger in-group social bonds. Several studies have questioned this claim by showing that immigration can reduce both bridging and bonding social capital thereby reducing trust between and within groups[2,34–36].

The Influence of the Finnish Government on the Evacuations

In the summer of 1940, the Finnish government passed the Emergency Settlement Act which aimed to ensure that Karelians who made their living from agriculture could continue to farm[37]. Although, Finnish authorities sought to reimburse farmers and hoped for voluntary sales, compulsory purchases were also made which left some owners resentful. Because implementation of the Emergency Settlement Act was slow, only about 13,000 new small farms were actually created between the Winter War and the Continuation War. During the Continuation War Karelians were given the opportunity to return to Karelia and those who received emergency resettlement farms were able cancel their contracts and by March of 1943 over half of them had done so[37,38]. The Continuation War ended in the fall of 1944 and the border was redrawn back to where it had been after the first armistice agreement with the Soviet Union was made in 1940. This resulted in the second evacuation from Karelia and the resettlement of this second wave of evacuees was more organized and systematic than the first. In May 1945, the Parliament approved the Land Acquisition Act, which guided the settlement policy and like the Emergency Settlement Act before it, the Land Acquisition act permitted the government to compel sales from private owners when needed.

Overall, there were an estimated 410,000 individuals displaced during the evacuation of Karelia[39]. Approximately 230,000 of these were farmers who received roughly 140,000 farms averaging 15 hectares of field and 30 hectares of forest 37,39,40. In May, 1945 the Finnish parliament approved the land acquisition act which entitled any evacuees who had owned or rented land in the ceded territories or who had received their principle income from agriculture to receive land in other parts of the country. Much of the land was taken from the state and the church but the demand was higher than could be accommodated so roughly 2/3 of the cultivated land, half the land that could be cleared for cultivation, and 1/3 of the forest land was seized from private owners41 who were compensated with government bonds yielding 4% interest. Some large landowners were forced to cede up to 80% of their farms, although those with fewer than 25 hectares (1 ha = 100 meters

X 100 meters) did not have to cede any land, hence some have argued that most landowners probably did not suffer that much from the resettlement[39]. A property expatriation tax was also collected to pay for the resettlement.[37]

The government also played an important role in determining where evacuees settled and an attempt was made to keep evacuees from the same towns together. In the first evacuation, each Karelian village was assigned to a target destination. For example, individuals from the largest city in Karelia, Viipuri and the surrounding areas were settled in and around Helsinki, the largest city in Finland. Individuals from the 2nd largest Karelian city, Sortavala, were moved to Jyvaskyla, a city in the middle part of Finland. Swedish speaking areas and Helsinki were protected from receiving too many evacuees and overall, attempts were made to move individuals from the same village to the same municipality. The most important factor in the decision of where to relocate the displaced, after availability of land, was the location of the village from which evacuees were displaced. Those from western Karelia were settled along the southern coast, while individuals from eastern Karelia were settled just north of the southern coast and those from northern Karelia were settled further north. None were placed in northern Finland (above latitude 66) due to the unfavorable conditions for agriculture. The destination of the non-agricultural population was not as explicitly outlined and was mainly determined by housing, distance from the ceded areas, family ties and employment opportunities[40,41].

Historical Trends

These data record the lives of people who were born between 1870 and 1925 and include information on their lives from their birth until they were interviewed in 1970. Therefore it is important to note three major demographic and historical trends over this century. First, over the period in which most of these individuals married and had children the GINI index (the most commonly used measure of inequality) for Finland fell from a peak of 0.62 in 1904 to an all-time low of 0.18 in 1947. This is one of the most dramatic declines in inequality ever documented for a western industrialized country[42]. Although the trend is exceptionally pronounced in Finland, it is part of a much broader pattern across Europe and the United States that has largely been attributed to the leveling effects of the two world wars[43]. Prior to World War 2, the overall income distributions in Karelia and western Finland are seen as being nearly identical[41] so this flattening of status differentials would have had similar effects on evacuees and resident Finns. Secondly, these data cover a time period of increasing industrialization in which people are migrating from rural to urban areas and there is a decline in the proportion of people working in agriculture. In 1920, 15% of Finns lived in urban areas and 70% worked in the agricultural sector but by 1970 the percent living in cities had increased to 45% and only 20% worked in agriculture[44]. Finally over this period Finland is experiencing a demographic transition where the mortality rate fell from 21.9 in 1900 to 9.6 in 1970 and the total fertility rate fell from 4.8 to 1.745. One important exception to this trend, however, was the spike in birth rates immediately after the war (1945-1955) in which the total fertility rate increases by approximately 35% over prewar levels, the so-called “baby boom” which was especially pronounced in Finland.

Although we are not able to determine causation with these data, results suggest an effect of age in many of our models. In general differences between groups decrease over time, such that earlier birth cohorts — individuals who were older at the time of the evacuation — show stronger effects. For example, the difference between the reproductive outcomes of marriages between Karelians and intermarriages are more pronounced for earlier birth cohorts than they are for later birth cohorts. This suggests that the tendency to develop bridging social connections is a property of the individuals themselves and that marrying a resident Finn or remaining in Finland during the war are just markers of more open or tolerant individuals. The diminishing differences between groups over time is also likely tied to the leveling effects of war and to the dramatic reduction in social, cultural and class differences over this period (1870-1939). This has implications for understanding why the integration of the Karelians is widely considered to be so successful[41]. Not only did the Karelians achieve exceptionally high rates of intermarriage — 75% of evacuee marriages were to western Finns after the war (Table S5) — but the government played an important role in compensating workers for lost land and possessions and in helping people to relocate. These factors, in addition to a mostly shared language, religion and nationality and the bonding effects of the Second World War, are all likely to have contributed to the rapid assimilation of evacuees into their host communities. If this overall homogenization had not occurred over the first half of the century, it is likely that we would have seen much larger reproductive and status differences between those who assimilated and those who did not and that the integration of the Karelians would likely have been met with more resistance.

Evacuations and Proportion of Migrants to Hosts

Evacuations were distributed more or less equally amongst high and low population density areas in Finland and there was no detectable relationship between the population of the destination location and the proportion of refugees relocated there (r= -0.041, p= 0.35). This does not mean, however, that evacuees were evenly distributed amongst the population. Using all individuals for which reliable data was available (N=48,921) we find that the proportion of evacuees to the local population ranged from 12% (for one town of

603 people) to less than 0.001% (one individual was evacuated to a town with a population of 6029) with a mean of 1.5% and a standard deviation of 0.2%. If these estimates are scaled to represent the 410,000 total refugees that historians estimate merged with approximately 3.3 million Finns, the proportion of evacuees to hosts in towns across Finland was roughly 12% with a standard deviation of 1.8%. Many evacuees did move from their initial evacuation sites, however, and by June of 1953 47% of the displaced were no longer living in their target municipalities37. The conscription of males into the army and excess male mortality during the war are also likely to have played an important role in mate choice both during and after the war and may help to explain some of the interactions between sex and returning to Karelia, such as why females who returned to Karelia are more likely to intermarry after the war than males (see table S2- bottom panel).

Prejudices Against Karelian Evacuees

In addition to their national identity, Finns often identify with their birth region and can easily recognise other Finns based on their local dialect. Karelian dialects can be divided into Southern and Central Karelia and both of these dialects are more similar to dialects concentrated in eastern non Karelian Finland than they are to dialects further west [46]. Therefore, the evacuees who moved further west had more distinctive accents than those who were closer to Karelia. Accents and dialects are some of the most reliable cues humans use to assess group membership and social identity[47] and are some of the best predictors of reduced trust and hostility towards out-groups[48]. Experiments have also shown that children are more likely to trust native speakers than those with accents [49]. Cultural stereotypes are also associated with some regions. Karelian evacuees encountered many of the same traumas and prejudices that immigrants face today and frequently attempted to hide their dialects and identities from locals[37,50]. An examination of the writing of Karelian forced migrants about their experiences decades after the resettlement also reveals deep cultural and social ties to their birth region[51]. During the Karelian resettlement in Finland, the great influx of people from a different cultural and often religious background brought out prejudices in the resident population, and the Karelians were often resented. Approximately 12% of the evacuees were Orthodox Christians and many of them had Russian surnames[52]. Both of these qualities were associated with support of the Socialists during the divisive Finnish Civil War of 1918 and with the enemy during World War II, Soviet Russia[53]. Many evacuees attempted to hide their Karelian accents and identities to avoid encountering negative reactions[50]. A survey conducted in 1950 found that 40% of resident Finns preferred to marry local residents rather than Karelians. The highest tolerance was found for residents living closer to the ceded territory and the least acceptance was in western Finland[37].

Supplementary Methods:

Open Science Framework Pre-registration

We pre-registered this project and hypotheses prior to accessing the data with the Open Science Framework. See: [Pre-registration] for pre-registered hypotheses, predictions, methods and expected analysis. This pre-registration created a frozen time stamped version of this project on September 29, 2017. This includes our methods, intended statistical analyses and hypotheses at that time. This registered version cannot be altered and was completed prior to our analysis of these data. We also submitted a pre-registration to Nature Human Behavior on January 24, 2018 with additional hypotheses and similar methods which we have included as an attachment with our pre-registration submission and can be accessed here: [Nature HB Pre-registration]. The main differences between our two pre-registrations is that in the OSF version we did not include any hypotheses concerning the reproductive outcome of the evacuees. These were added later to the pre-registration that we submitted to Nature Human Behaviour. The only significant change between this document and our current manuscript concerns how we deal with missing data. In both of our pre-registrations we claimed that we would attempt to impute all missing data that met certain criteria. This was not possible, however, with either the regular or experimental branch of the rethinking package we used to try impute the data: install_github (”rmcelreath/rethinking”,ref=”Experimental”). Every time we had more than approximately a thousand data points to impute (calculated as new parameters) in the model, the Markov chains failed to properly converge. This was unexpected and all analyses therefore only include individuals on whom we had complete cases for all variables entered in the model (see Supplementary materials: Missing Data and Selection Bias).

Social Status and Occupations

In addition to dummy coding occupations that required an education (1) and those that did not (0) we also grouped occupations into the following 7 classes as defined by the 1950 Finnish census: (a) technical professionals, teachers and free professions; (b) office workers, directors and typists; (c) business and selling; (d) agriculture and forestry related; (e) transportation; (f) factory workers and craftsmen and (g) service industry. For social class we used an ordinal ranking of occupations into seven categories defined by Waris for 1940 Finland [37]: (a) High (business owners, academics, lawyers, doctors) ; (b) Upper class (civil servants, academics, teachers, farmers with land larger than 50 hectares); (c) Middle class (entrepreneurs, post office, police, telephone, government workers, office workers and farmers with land between 15 and 50 hectares); (d) Farmers with land smaller than 15 hectares; (e) Skilled workers (builders, construction, electric, machinists etc.); (f) Unskilled workers (wage employees, unspecified factory or railway work) and (g) Poor (unemployed, cleaners, maids, farm hands). Hypergamy was calculated using these seven social classes and positive values indicate that the individual had married someone from a higher social class (e.g. an electrician who married a doctor received a positive hypergamy score of 1). Individuals who were listed as housewives or pensioners were not given any social class ranking and farmers' wives were given the same social status as their husbands because we had no way of determining who had owned, bought or inherited the farm prior to marriage.

Random Effects

Although all of the models yielded considerably lower WAIC scores when birthplace id was entered as a random effect, we also ran them without entering birthplace id as a random effect and the parameter estimates were nearly identical to the estimates shown in Tables S1-S4. To generate a measure of how much of the variance is explained, we also ran the model in a maximum likelihood framework. These models produced very similar parameter estimates to the Bayesian models and showed that across 52 groups entering birthplace explained 0.026 of the variance in the full intermarriage model and 0.012 of the variance in the full reproductive outcomes model. We also conducted a Mantel test in R to check for spatial autocorrelation between our two outcome variables and birthplace location. The observed correlation between the spatial distances of birthplaces and an evacuees number of children was $r = 0.036$, $p= 0.0236$ which suggests that the distance matrices are very slightly positively associated and that smaller differences in number of children are generally seen among pairs of birthplaces that are closer to each other. The observed correlation between the spatial distances of birthplace and whether an evacuees married another Karelian or not was $r = 0.053$, $p<0.001$ which also suggests that the distance matrices are very slightly positively associated and that smaller differences in the likelihood of intermarriage are generally seen among pairs of birthplaces that are closer to each other.

Model Selection and Interactions

We developed two models to test our hypotheses and used candidate sets of the explanatory variables described above to model each of the two dependent variables in a Bayesian Generalized Linear Mixed Model regression in R Studio 3.3.3. The following candidate predictor variables and dependent variables were entered into both main models: sex, age, whether or not their occupation required an education (0=no, 1=yes), the 7 occupational categories from the 1950 census described above (technical profession, office worker, business, agricultural, transportation, factory workers and the service industry), hypergamy, returned to Karelia, education and married after 1945. Intermarriage was added as a covariate to the model predicting reproductive outcomes. All possible interactions of returned to Karelia and married after 1945 with both sex and age were also entered into each model. Married after 1945 X hypergamy was only added to the intermarriage model. Interactions between intermarriage and the following covariates: sex, returned to Karelia, married after 1945 and hypergamy were included in the reproductive outcomes models. Place of birth was entered as a random effect in all models to control for the non-independence of evacuees who were born in the same town or village. These models were all run on the Taito supercluster[54]. All combinations of our candidate predictor variables and interactions were systematically entered into each model and run independently. The 'compare' function in the 'Rethinking' package in R version 3.3.3 was used to assess model fit, rank and weight the models. Akaike 'weights' were determined by converting and standardizing WAIC scores to estimate the probability that the model will make the best predictions on new data. The parameters included in the final models were all covariates generated from the model that received any weight. For example, even though the interaction between Sex and 'Married after the war' was not included in the reproductive outcomes model that received the lowest WAIC score, this model did receive 0.45 percent of the weight. Therefore we used both of these top 2 models to generate posterior distributions such that the predictions were drawn based on the weight of the models (i.e. 55% from the model that included these interactions and 45% from the one that did not (see Table S10).

Missing Data and Selection Bias

There were 77,512 subjects who met the basic criteria — born in Karelia, lived there immediately prior to the evacuation and were directly interviewed for the project — to be included in these analyses. Missing data were inconsistent across variables and any subjects missing any of the following variables were excluded. Sex was determined from the full names (including maiden names) of individuals and there were 1,607 individuals for which sex could not be accurately determined. There were 10,593 individuals for whom occupation could either not be determined or credibly categorized, 21,127 missing cases for whom social class could not be reliably assessed, 42,220 subjects for whom wedding year was missing, 955 subjects for whom the population of their birthplace was unavailable, 3,968 individuals for whom it was unknown whether or not they returned to Karelia between the wars, 13,750 individuals for whom education could not be confidently assessed, 19,871 evacuees for whom we could not accurately determine whether they had married a Karelian or someone from western Finland and 61,862 individuals who were lacking information on the size of their farms. Most of this last category were not farmers, however. Using only individuals for which we had a complete set of observations for all variables entered into the model generated a sample size of 26,775 individuals for the models using all evacuees (Table S1, Figures S2 and S2). Of these 21,134 were married before 1945 and 5,623 after (Figures 2a, 2b and Tables S2), 17,333 returned to Karelia and 9,424 remained in western Finland throughout the war (Table S3). These two groups — married before vs after the war and returned vs remained — were delimited further into the following four combinations: married before 1945 and returned (N=14,326), married before and remained (N=6,808), married after 1945 and returned (N=3,007) and married after 1945 and remained (N=2,616).

Evacuees who were over the age of 45 when the evacuations began would have to have survived to age 75 to be interviewed and are therefore particularly likely to be missing from these data. This is a problem if mortality rates between the war and the time of the interview are correlated with the environmental conditions that we are interested in (i.e. intermarriage or returning to Karelia) or by any particular reproductive strategy (e.g. women are more likely to die during childbirth). Although we cannot be certain if the differential survival of evacuees between the war and 1970 introduces selection bias into our data, we doubt that this is a serious problem for the following reasons. First, for evacuees who were under the age of 45, mortality between the war and the interview was unlikely to be related to an evacuee's age because the major reductions in mortality for Finns born between 1870 and 1926 (the birth years covered by these data and analyses) were for children under the age of 15. These individuals saw their life expectancy rise by approximately ten years if they were born in 1870 as opposed to 1930. The reductions in mortality for individuals who had survived to age 15 and 65 respectively over this time span were much more modest and life expectancy increased by less than a year for males and females who had survived to the age of 15 over this time period ([54] see Table 1).

However, major changes in child and infant mortality are unlikely to have an effect on these results because all of the evacuees used in our sample were at least 14 years old when the war began because we were primarily interested in measuring the marriage and reproductive decisions and outcomes of sexually mature adults. Older individuals are more likely to be missing from our data simply because they were more likely to die prior to the interviews which were conducted in 1970. But their data is only completely missing if both spouses died prior to 1970. If either of them survived then we do have a record of their lifetime reproductive success. Of course this does leave the potential for sex biases in our data because females who survive to age 15 achieve greater gains in life expectancy than males who survive to age 15 (six years vs two years over the time period covered). By including sex and age and their interactions with the key variables of interest this possibility has been minimized.

Nevertheless, even if evacuees who returned to Karelia died in much higher numbers than those who remained (and we have seen no evidence that this is the case) and are therefore missing from these analyses, it is difficult to imagine that the loss of these individuals would be high enough that it would pose serious problems for these analyses. We were able to analyze mortality rates for a small subset of our population (1,355 individuals) by linking our data by their names and birthdates to a dataset of genealogical church records called 'Katiha' which recorded the year of death for some of the evacuees who were not directly interviewed. Unfortunately these records only continue through 1949 so any deaths after this year were not recorded. However, prior to 1949 the mean age at death for individuals who returned to Karelia was approximately the same as it was for individuals who remained in Finland : 17.8 for evacuees who returned vs 17.6 for evacuees who remained. It was also virtually the same for individuals who married people from western Finland (18.1) vs those who married fellow Karelians (17.8 years old). These data also show that the majority of deaths in our data are likely to be prior to age 20 which is before either the mean age at marriage for our population (27.4 years old) or the mean age at first birth amongst the evacuee population (27.3 years old). The relationship between reproduction and maternal mortality while pregnant or within 45 days of childbirth reveals a major reduction in maternal mortality from 425 per 100,000 births in 1911 to 11 per 100,000 in 1970. However, even using the highest risk level over this period of 425 in 1911 yields a risk of death increase of 0.42% per birth. Although this must be considered a significant risk factor, it is unclear how the differences we report in reproductive outcomes by either marrying a Karelian or a resident Finn or returning or remaining (across all occupations, social class and ages) might be affected by this increased risk.

A more likely source of bias which which may have affected our results stems from the different environments experienced between those who returned to Karelia and those who remained in western Finland and the evidence for differential mortality between these groups is mixed. A study showing that evacuees had higher overall mortality rates, with particularly elevated risks of heart disease, compared to the resident population between 1971 and 2010 provides support for this interpretation[56]. Another study using different health outcomes and criteria, however, showed no adverse health consequences for Karelians who were under the age of 17 when they were forced to evacuate [57]. However, it should be noted that even if mortality rates between the war and the time of the interview are uncorrelated with environmental conditions differentially affecting evacuees who returned to Karelia, when both spouses died prior to 1970, they are missing from our sample (e.g. over the age of 45 when the evacuations began). Although we cannot be certain that non random mortality of evacuees between the war and the interview does not introduce selection bias into our analysis it is unclear how this potential bias would affect mate choice or reproductive outcomes across all age classes, especially for individuals who married after the war.

Model Validity, Effects and Specifications

To assess the validity of these models and see how well model predictions match the observed data we conducted a posterior predictive check (for results see Supplementary Materials: Posterior Predictive Check and Figures S3a-c and S4a-c). Bayesian models are generative so the posterior distributions produced by these models can be used to make specific predictions on counterfactual data. This means that we can also determine the absolute effects — the practical change in the probability of an outcome occurring that depends on the values of all of the other covariates in the model — that specific parameters of interest have on outcomes. Here we are effectively constructing posterior predictions for a previously unobserved, fictitious and often impossible evacuee. This might be a male who is of average age, has an average education, has the average of all occupations and was born in an unobserved town (the cluster variable has a varying intercept of 0) which has the average population.

Hamiltonian Monte Carlo Chains programmed in STAN were used to generate posterior distributions. We specified broad but weakly regularizing priors to tamp the effects of extreme values: normal distributions centered on 0 for most parameters, normal distributions centered on null hypothesized isometric slopes for continuously varying covariates, and Cauchy distributions with a shape parameter of 2 for standard deviations. Models were run with four replicate chains for 10,000 MCMC iterations with a 20% warm up. All statistical analyses were performed in R version 3.5.1. Bayesian inference was carried out using the rstan package for R (version 2.14.1; https://cran.r-project.org/web/packages/ rstan/index.html), an interface to Stan which uses a Hamiltonian Monte Carlo sampler[58]. We used the rethinking package in R (version 1.59; https://github.com/rmcelreath/ rethinking), which includes convenience functions for building, sampling, and summarizing models[59]. For code and exact specifications for all models (see R code for all Models).

Posterior Predictive Check

Posterior predictive checks are a method for simulating replicated data under the fitted model and then comparing these to the observed data[60]. They are used to look for systematic discrepancies between real and simulated data by comparing the distribution of random draws of new data generated by the model to the observed data[60]. In other words, posterior predictive checks simulate data generated by the model and compare these data to the actual observations[57]. This approach relies on the basic idea that if a model is specified correctly, then the replicated data predicted by the model should look similar to the observed data. In multilevel models, however, we do not expect the model to exactly reverse engineer the data. This is because one of the major aims of using multilevel models with varying effects (here the model estimates a different intercept for each birthplace id) is to trade within sample fit for better out of sample predictions. This is what happens when the model downweights extreme or rare observations and almost always results in a more conservative predictions. Regularized models are therefore seen to be more conservative that unregularized models due to this type of shrinkage and even perfectly good models are expected to differ from the raw data in systematic ways[59]. The intent of a posterior predictive check is not to test whether a given model is "true", but rather to make sure that the model is not misspecified and that it at least approximates the observed data56. Unlike maximum likelihood estimates whereby the parameter estimates are set at single values, using a Bayesian framework preserves the uncertainty around the estimates because the data are generated from parameter values randomly drawn from the posterior distribution.

For the binomial outcome variables (intermarriage) we simulated 10,000 predicted values for each observation in the model and compared these model generated predictions with the values observed in the data. The model we used to predict the likelihood of intermarriage for all evacuees accurately predicted the observed values (i.e. 0 or 1) 72% of the time (see Figure S3a). The model used to predict the likelihood of intermarriage before the war predicted the observed values 73% of the time (see Figure S3b) and the model used to predict the likelihood of intermarriage after the war predicted the observed values 67% of the time(see Figure S3c). For the Poisson distributed outcome variable — number of children — we did not expect that the model would be able to accurately predict the exact number of children due to shrinkage whereby higher values regress to the mean when the model pools data. Therefore, to test the model's ability to accurately predict the number of children we simulated 10,000 model generated replications for each observation and generated 89% credibility intervals around these distributions. Next we calculated what percentage of the observed data were contained within these intervals. We found that the 87% of the observed data was within the 95% credibility interval generated by the model used to predict reproductive outcomes for all evacuees (see

Figure S4a). We found that the 86% of the observed data was within the 95% credibility interval generated by the model used to predict reproductive outcomes for evacuees who were married before the war (see Figure S4b) and that 92% of the observed data was within the 95% credibility interval generated by the model used to predict reproductive outcomes for evacuees who were married after the war (see Figure S4c).

R Code for Main Models

Here is the mathematical form of the main model and interactions using all the data:

Intermarriage:

$Marriage_i \sim Binomial(1, p_i)$ [Likelihood]

$logit(p_i) <- birthplace[i] + \beta_s Sex_i + \beta_a Age_i + \beta_{\text{hyp}} Hypergamy_i + \beta_{\text{ret}} Returned_i +$
$\beta_{\text{pop}} Population_i + \beta_{\text{edu}} Education_i + \beta_{\text{agr}} Agriculture_i + \beta_{\text{tech}} Tech_i + \beta_{\text{fact}} Factory_i +$
$\beta_{\text{serv}} Service_i + \beta_{\text{off}} Office_i + \beta_{\text{trans}} Transportation_i + \beta_{\text{maw}} Married\_after\_war_i +$
$\beta_{\text{rets}} Returned_i X Sex_i + \beta_{\text{reta}} Returned_i X Age_i + \beta_{\text{mawret}} Married\_after\_war_i X Returned_i +$
$\beta_{\text{maws}} Married\_after\_war_i X Sex_i +$
$\beta_{\text{mawhyp}} Married\_after\_war_i X Hypergamy_i$ [Linear Model]

And here is the R code

```
marriage_model <- map2stan(
alist(
outbred ~ dbinom (1,p), logit(p) <- a + a_birthplace[birthplace_id_seq] + bs * sex + bage * age +
bhyp * hypergamy + brk * returned_karelia + bpop * population + bed * education+
bag * agriculture + btech * technical + boff * office + bbus * business + btrans * transport +
bfact * factory + bserv * service + ma * married_after_1945 + brks * returned_karelia * sex +
brka * returned_karelia * age + mark * married_after_1945 * returned_karelia +
mas * married_after_1945 * sex + mah * married_after_1945 * hypergamy
a_birthplace[birthplace_id_seq] ~ dnorm(0, sigma),
sigma ~ dcauchy(0,1),
a_c ~ dnorm(0,1),
a ~ dnorm (0,1),
c (bs, bage, bpop, bag, bhyp, bpop, bed, bag, btech, boff, bbus, btrans, bfact, bserv, ma, brks, brka,
mark, mas, mah) ~ dnorm(0,1)),
data=data_list, iter=8000, warmup=2000, control=list(max_treedepth=20),
start=list(bs=0, bage=0, bpop=0, bag=0, bhyp=0, bpop=0, bed=0, bag=0, btech=0, boff=0,
bbus=0, btrans=0, bfact=0, bserv=0, ma=0, brks=0, brka=0, mark=0, mas=0, mah=0)
```

Reproductive outcomes:

Here is the mathematical form of the main model and interactions using all the data:

$Kids_i \sim Poisson(\lambda_i)$ [Likelihood]

$log(\lambda_i) <- birthplace[i] + \beta_s Sex_i + \beta_a Age_i + \beta_{\text{hyp}} Hypergamy_i + \beta_{\text{ret}} Returned_i +$
$\beta_{\text{int}} Intermarried_i + \beta_{\text{pop}} Population_i + \beta_{\text{edu}} Education_i + \beta_{\text{agr}} Agriculture_i + \beta_{\text{tech}} Tech_i +$
$\beta_{\text{fact}} Factory_i + \beta_{\text{serv}} Service_i + \beta_{\text{off}} Office_i + \beta_{\text{trans}} Transportation_i + \beta_{\text{maw}} Married\_after\_war_i +$
$\beta_{\text{rets}} Returned_i X Sex_i + \beta_{\text{reta}} Returned_i X Age_i + \beta_{\text{mawret}} Married\_after\_war_i X Returned_i +$
$\beta_{\text{maws}} Married\_after\_war_i X Sex_i + \beta_{\text{mawhyp}} Married\_after\_war_i X Hypergamy_i +$
$\beta_{\text{ints}} Intermarrried_i X Sex_i + \beta_{\text{intret}} Intermarrried_i X Returned_i +$
$\beta_{\text{intma}} Intermarrried_i X Married\_after\_war_i +$
$\beta_{\text{inthyp}} Intermarrried_i X Hypergamy_i$ [Linear Model]

And here is the R code:

```
kids_model <- map2stan(
alist(
kids ~ dpois (lambda),
log(lambda) <- a + a_birthplace[birthplace_id_seq] + bs * sex + bage * age +
bhyp * hypergamy + brk * returned_karelia + bim * intermarriage + bpop * population +
bed * education+ bag * agriculture + btech * technical + boff * office + bbus * business +
btrans * transport + bfact * factory + bserv * service + ma * married_after_1945 +
brks * returned_karelia * sex + brka * returned_karelia * age +
mark * married_after_1945 * returned_karelia + mas * married_after_1945 * sex +
mah * married_after_1945 * hypergamy + bims * intermarriage * sex +
bimhyp * intermarriage * hypergamy + bimaw * intermarriage * married_after_1945,
a_birthplace[birthplace_id_seq] ~ dnorm(0, sigma),
sigma ~ dcauchy(0,1),
a_c ~ dnorm(0,1),
a ~ dnorm (0,1),
c (bs, bage, bpop, bag, bhyp, bpop, bed, bag, btech, boff, bbus, btrans, bfact, bserv, ma, brks, brka,
mark, mas, mah, bim, bims, bimhyp, bimaw, ~ dnorm(0,1)),
data=data_list, iter=8000, warmup=2000, control=list(max_treedepth=20),
start=list(bs=0, bage=0, bpop=0, bag=0, bhyp=0, bpop=0, bed=0, bag=0, btech=0, boff=0,
bbus=0, btrans=0, bfact=0, bserv=0, ma=0, brks=0, brka=0, mark=0, mas=0, mah=0,
bim, bims, bimhyp, bimaw)
```

See public repository file 'Nature HB revisions.r ' on Github for full code and data selection criteria for both models: [Github public repository]

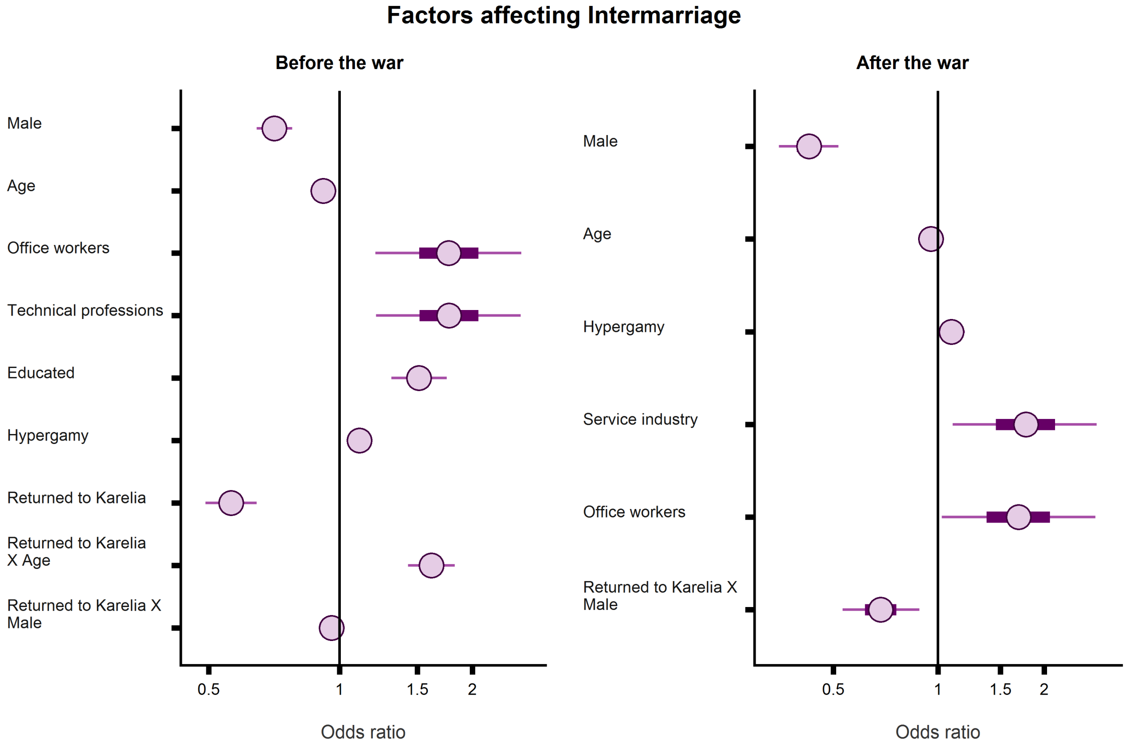
Description of Data

Evacuees who were married before 1945 married Finns from other parts of the country 24% of the time and they had an average of 0.68 fewer children than those marrying fellow Karelians. After the war 75% of them married into the host population, and they had an average of 0.06 more children than those people who married fellow Karelians. Approximately 68% of evacuees who were married before 1945 returned to Karelia between 1941 and 1944 and they had an average of 0.54 more children than evacuees who remained in western Finland. Approximately 53% of evacuees who were married after 1945 had returned to Karelia and they had an average of 0.26 more children than those who remained in western Finland (see Table S5, for frequencies, sample sizes and means). Before the war 2,972 Karelians married someone from a lower social class with 1,874 of these marrying a Karelian and 1,098 marrying a resident Finn; 15,072 married someone from the same class with 12,322 of these marrying a Karelian and 2,750 marrying a resident Finn; and 3,090 married someone who was from a higher social class with 1,849 of these marrying a Karelian and 1,241 marrying a resident Finn. After the war 1,372 Karelians married someone from a lower social class with 342 marrying a Karelian and 1,030 marrying a resident Finn; 3,037 married a spouse from the same social class with 810 of these marrying a Karelian and 2,227 marrying a resident Finn; and 1,214 married someone who was from a higher social class with 236 of these marrying a Karelian and 978 marrying a resident Finn (Table S7). There was also a strong and positive relationship between age and reproductive success ($r=0.13$, $p<0.001$) across the entire dataset such that earlier birth cohorts had more children. This is consistent with the ongoing demographic transition of the study period. For interactive figures and charts for all variables and combinations used in these analyses see: [Shiny app]

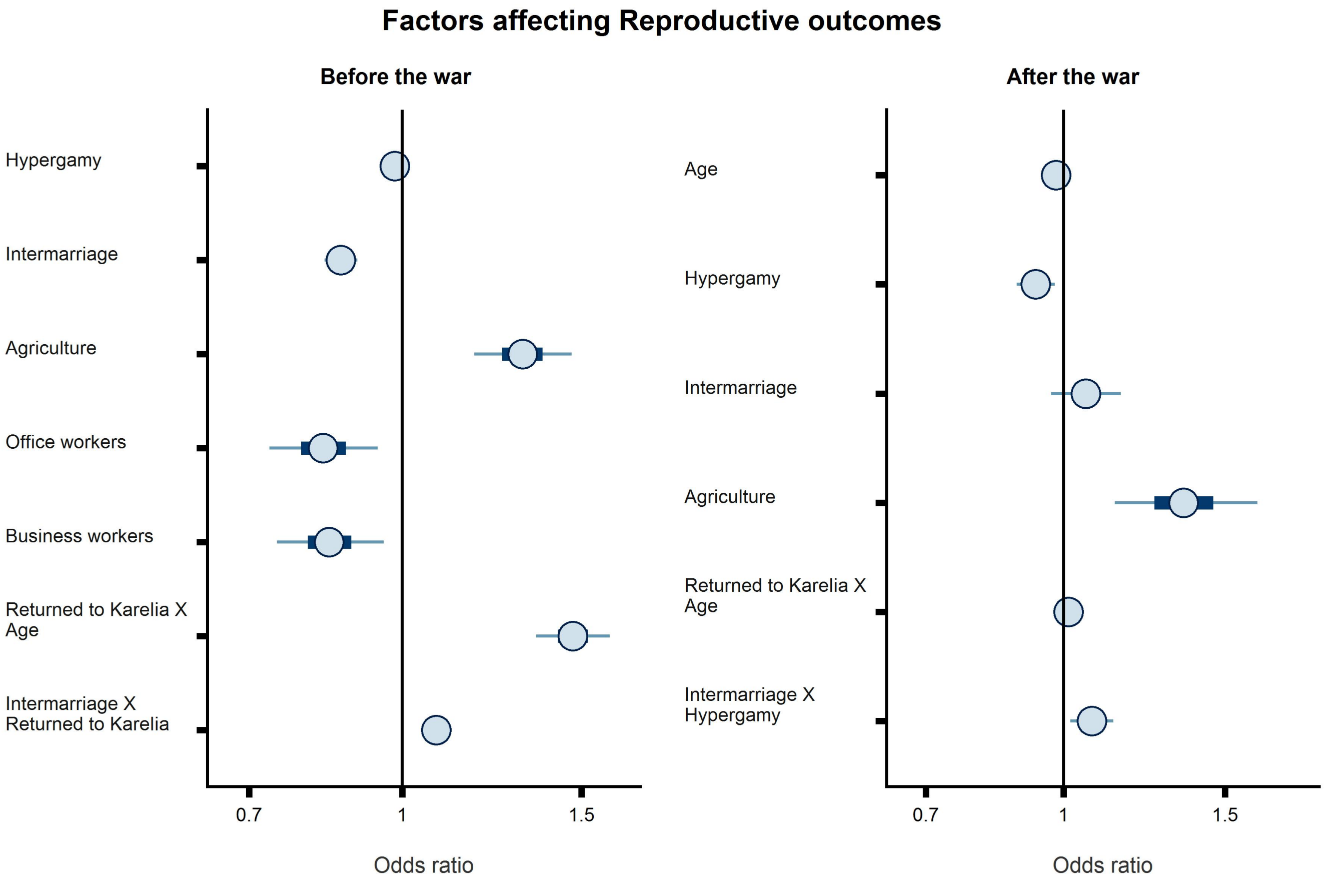
Variables Dropped from Models

We also flagged 8,432 individuals as being members of 'Karjalaseura' — a Karelian society which aims to promote and preserve Karelian culture — which we suggest is indicative of bonding social capital. Although this variable was entered into the model assessing reproductive outcomes, it was dropped from the final model (see Supplementary Materials: Model Selection). This was likely due to the fact that membership in this organization is positively correlated with the likelihood of returning to Karelia and negatively correlated with the likelihood of intermarriage (Table S6). When entered into the model alone, however, membership in Karjalaseura positively predicts number of children ($B=0.04$, $SE= 0.008$, $p<0.001$***). Overall evacuees who were a member of this society had an average of 2.80 (S.E. 0.02) children and those who were not members had an average of 2.65 (S.E. 0.008). This provides additional support for our assumptions that returning to Karelia between the wars and marrying a fellow Karelian are reasonable proxies for stronger in-group social networks and that this group has higher lifetime reproductive success. There were large differences between the amount of land owned by farmers so we also analyzed this separately. Farmers who owned larger plots of land in western Finland after the evacuation (more total hectares) were more likely to marry resident Finns (B= 6.25, SE 0.6, $p < 0.001$***) and had more children (B= 1.36, SE 1.4, $p<0.001$***). However, farm size had no detectable impact on the likelihood of returning to Karelia (B= -0.46, SE 0.55, $p=0.40$).

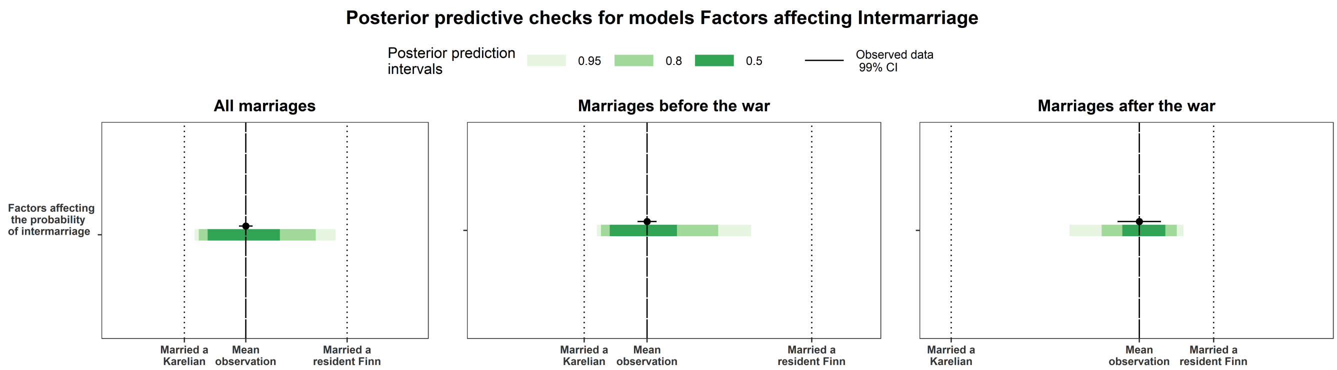
Supplementary Figures:



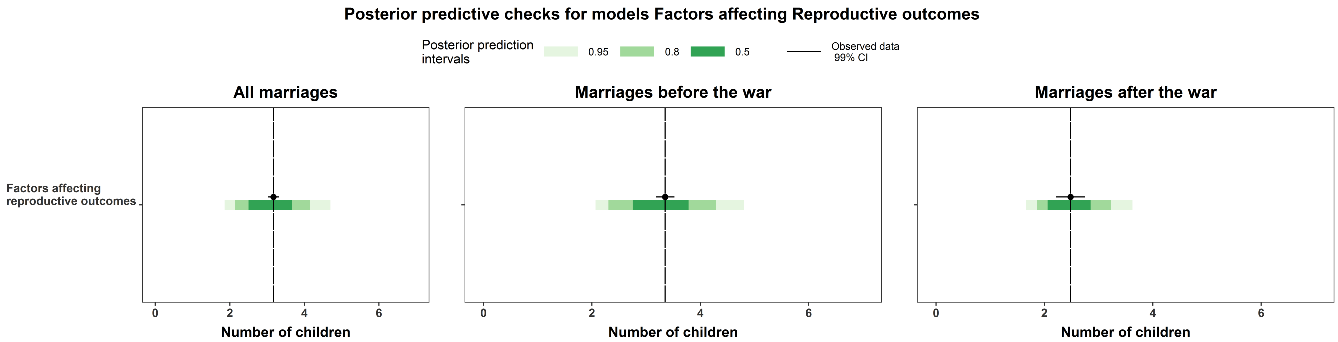
Supplementary Figure 1: Women, younger evacuees, those who returned to Karelia, evacuees who marry a spouse higher in social status, more educated evacuees (before the war only), office workers and people in technical professions are all more likely to intermarry. Analysis is subdivided into pre and postwar marriages unlike in the main analysis which includes all evacuees shown in Figure 2a and Table S1. Distributions display the odds ratio or the proportional change in the outcome induced by each predictor (mean - open circle, 50% HDI - thick line and 95% HDI's interval narrow line). See table S2- upper panel for median estimates and 95% HDI's for all parameters included in this model.



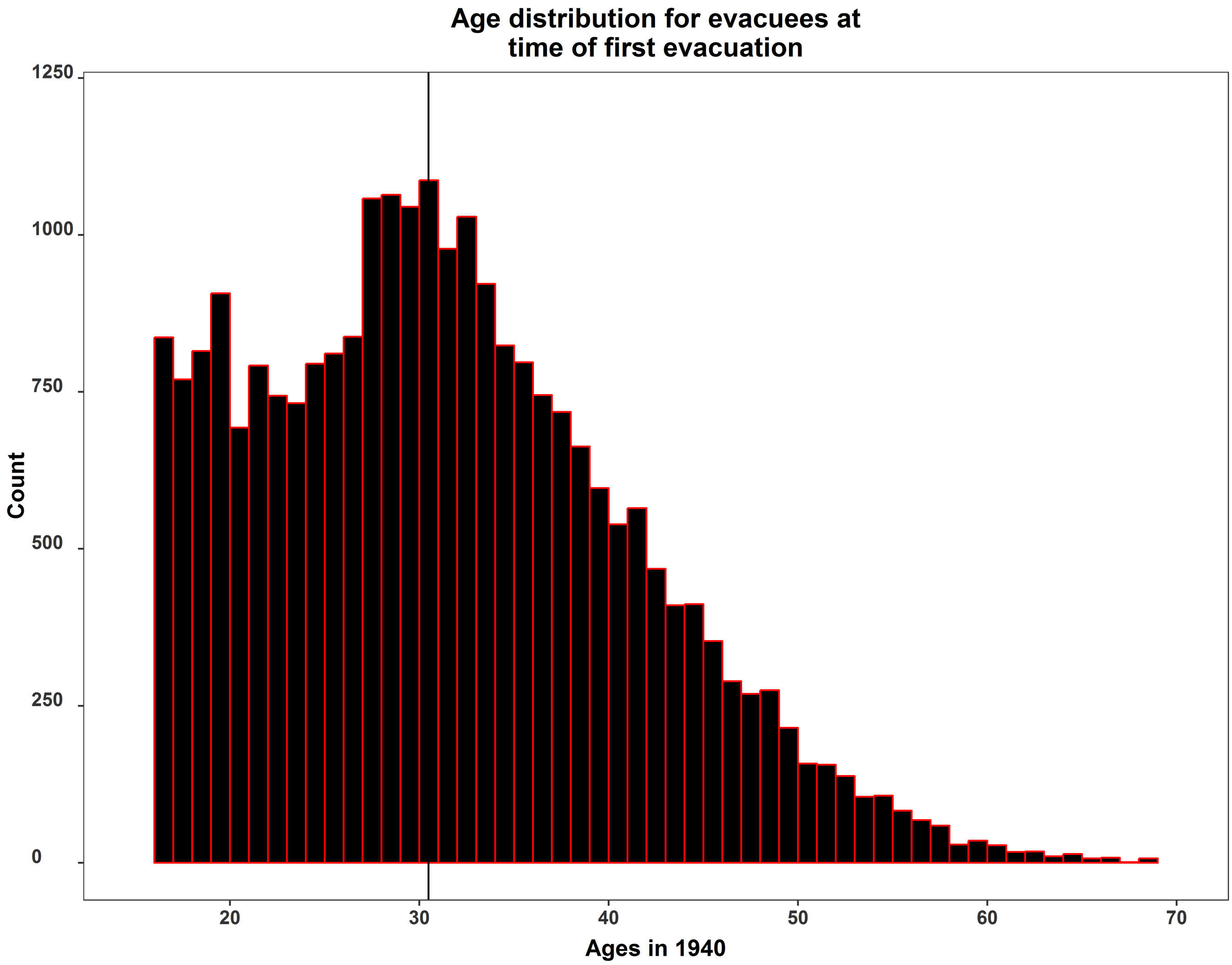
Supplementary Figure 2: Evacuees who married fellow Karelians before the war and married western Finns after the war; evacuees who returned to Karelia (especially if they were older) and farmers all have more children. At the same time office workers and business workers who were married before the war have fewer children. Analysis is subdivided into pre and postwar marriages unlike in the main analysis which includes all evacuees shown in Figure 2a and Table S1. Distributions display the odds ratio or the proportional change in the outcome induced by each predictor (mean - open circle, 50% HDI - thick line and 95% HDI's interval narrow line). See table S2- lower panel for median estimates and 95% HDI's for all parameters included in this model.



Supplementary Figure 3a-3c: Posterior predictive check for models predicting the likelihood of intermarriage (see Tables S1 upper panel for all marriages, Table S2 - top of upper panel for marriages before the war and Table S2 - top of lower panel for marriages after the war. Model prediction credibility intervals (95%, 80% and 50%) in shades of green compared to the mean (black circle) and +/- 99% CI (black segment) of the observed data.



Supplementary Figure 4a-4c: Posterior predictive check for models predicting reproductive outcomes (see Tables S1 - lower panel for all marriages, S2 - top of upper panel for marriages before the war and S2 -bottom of upper panel for marriages after the war. Model prediction credibility intervals (95%, 80% and 50%) in shades of green compared to the mean (black circle) and +/- 99% CI (black segment) of the observed data.



Supplementary Figure 5: Distribution of evacuee ages in 1940 used for main models for all marriages (N=26,757) (Figures 2a and 2b and Table S1). Solid black line at mean.

Supplementary Tables:

All EVACUEES

Model	Predictor	Mean	5% HDI	95% HDI
Factors affecting the probability of intermarriage *[N= 26,757]*	Intercept*	0.85	0.49	1.21
	Male*	-0.27	-0.35	-0.18
	Age*	-0.11	-0.08	-0.07
	Hypergamy*	0.09	0.04	0.14
	Returned to Karelia*	-0.65	-0.77	-0.53
	Population of birthplace	0.08	-0.26	0.41
	Education*	0.29	0.07	0.17
	Agriculture*	-0.31	-0.60	-0.01
	Technical professions*	0.53	0.20	0.84
	Factory workers	0.14	-0.15	0.44
	Service industry	0.28	-0.04	0.57
	Office workers*	0.56	0.23	0.89
	Business workers	0.13	-0.20	0.44
	Transportation industry	0.08	-0.23	0.41
	Married after 1945*	1.81	1.66	1.96
	Returned to Karelia X Male*	0.32	0.21	0.42
	Returned to Karelia X Age*	-0.03	-0.04	-0.03
	Married after 1945 X Returned to Karelia*	0.56	0 .43	0.70
	Married after 1945 X Male*	-1.00	-1.14	-0.86
	Married after 1945 X Hypergamy*	0.11	0.01	0.20
Factors affecting reproductive outcomes *[N= 26,757]*	Intercept*	1.10	0.97	1.23
	Male	0.00	-0.02	0.02
	Age*	-0.01	-0.01	0.00
	Hypergamy*	-0.02	-0.04	-0.01
	Intermarriage*	-0.11	-0.14	-0.08
	Returned to Karelia*	0.06	0.03	0.09
	Population of birthplace	0.00	-0.17	0.16
	Education	0.00	-0.04	0.03
	Agriculture*	0.28	0.19	0.38
	Technical professions	0.00	-0.10	0.10
	Factory workers	-0.06	-0.15	0.04
	Service industry	-0.03	-0.12	0.07
	Office workers*	-0.13	-0.23	-0.03
	Business workers*	-0.14	-0.24	-0.04
	Transportation industry	-0.07	-0.17	0.03
	Married after 1945*	-0.37	-0.45	-0.33
	Returned to Karelia X Male	-0.01	-0.03	0.02
	Returned to Karelia X Age*	0.01	0.01	0.02
	Married after 1945 X Returned to Karelia*	0.07	0.04	0.11
	Married after 1945 X Male*	0.10	0.06	0.13
	Intermarriage X Male	-0.02	-0.05	0.01
	Intermarriage X Returned to Karelia*	0.06	0.03	0.09
	Intermarriage X Hypergamy*	0.01	-0.01	0.03
	Intermarriage X Married after 1945*	0.17	0.13	0.20

Supplementary Table 1: Parameter estimates and 95% HDI's for predictors and interactions in top ranked models. Parameter estimate means and HDI's are for the relative effect (i.e. the proportional change in the outcome) induced by the predictor. *95% HDI does not overlap with 0.

Evacuees who were married before 1945 *[N= 21,134]*

Model	Predictor	Mean	5% HDI	95% HDI
Factors affecting the probability of intermarriage	Intercept*	1.07	0.63	1.48
	Male*	-0.34	-0.43	-0.25
	Age*	-0.09	-0.09	-0.08
	Hypergamy*	0.10	0.06	0.16

	Returned to Karelia*	-0.57	-0.71	-0.45
	Population of birthplace	0.04	-0.36	0.44
	Education*	0.42	0.28	0.57
	Agriculture	-0.39	-0.73	0.05
	Technical professions*	0.58	0.20	0.94
	Factory workers	0.11	-0.24	0.45
	Service industry	0.18	-0.17	0.53
	Office workers*	0.58	0.20	0.95
	Business workers	0.08	-0.28	0.44
	Transportation industry	0.04	-0.31	0.42
	Returned to Karelia X Male*	0.48	0.36	0.60
	Returned to Karelia X Age*	-0.04	-0.05	-0.03
Factors affecting reproductive outcomes	Intercept*	1.02	0.87	1.17
	Male	0.00	-0.02	0.03
	Age	0.00	-0.01	0.01
	Hypergamy*	-0.02	-0.03	0.00
	Returned to Karelia	-0.14	-0.18	0.10
	Intermarriage*	-0.11	-0.13	-0.08
	Population of birthplace	0.08	-0.10	0.25
	Education	0.01	-0.03	0.05
	Agriculture*	0.28	0.17	0.39
	Technical professions	-0.06	-0.18	0.05
	Factory workers	-0.06	-0.17	0.05
	Service industry	-0.04	-0.15	0.07
	Office workers*	-0.18	-0.30	-0.06
	Business workers*	-0.17	-0.28	-0.05
	Transportation industry	-0.10	-0.22	0.01
	Returned to Karelia X Male	-0.01	-0.04	0.01
	Returned to Karelia X Age*	0.01	0.01	0.01
	Intermarriage X Male	-0.02	-0.05	0.02
	Intermarriage X Returned to Karelia*	0.08	0.05	0.11
	Intermarriage X Hypergamy	0.00	-0.03	0.03

Evacuees who were married after 1945 *[N= 5,623]*

Model	**Predictor**	**Mean**	**5% HDI**	**95% HDI**
Factors affecting the probability of intermarriage	Intercept*	3.00	2.53	3.52
	Male*	-0.85	-1.04	-0.66
	Age*	-0.04	-0.06	-0.04
	Hypergamy*	0.09	0.00	0.17
	Returned to Karelia	0.20	-0.04	0.44
	Population of birthplace	0.15	-0.23	0.53
	Education	-0.07	-0.28	0.13
	Agriculture	0.05	-0.36	0.47
	Technical professions	0.42	-0.02	0.88
	Factory workers	0.25	-0.17	0.67
	Service industry*	0.58	0.12	1.04
	Office workers*	0.53	0.03	1.01
	Business workers	0.16	-0.29	0.65
	Transportation industry	0.28	-0.19	0.71
	Returned to Karelia X Male*	-0.38	-0.63	-0.14
	Returned to Karelia X Age	-0.01	-0.02	0.01
Factors affecting reproductive outcomes	Intercept*	0.91	0.67	1.14
	Male	0.08	-0.01	0.16
	Age*	-0.03	-0.04	-0.02
	Hypergamy*	-0.07	-0.12	-0.02
	Returned to Karelia	-0.05	-0.14	0.04
	Intermarriage*	0.06	-0.03	0.14
	Population of birthplace	-0.18	-0.38	0.03

Education	-0.02	-0.08	0.04
Agriculture*	0.31	0.13	0.48
Technical professions	0.11	-0.09	0.28
Factory workers	-0.05	-0.23	0.15
Service industry	0.02	-0.16	0.20
Office workers	-0.06	-0.25	0.13
Business workers	-0.08	-0.27	0.11
Transportation industry	0.00	-0.18	0.18
Returned to Karelia X Male	0.01	-0.05	0.07
Returned to Karelia X Age*	0.02	0.01	0.03
Intermarriage X Male	0.00	-0.08	0.09
Intermarriage X Returned to Karelia	-0.03	-0.10	0.04
Intermarriage X Hypergamy*	0.07	0.02	0.13

Supplementary Table 2: Parameter estimates and 95% highest density intervals (HDI's) for all predictors subdivided by evacuees who were married before 1945 (top panels) and for evacuees who were married after 1945 (bottom panels). Parameter estimate means and HDI's are for the relative effect (i.e. the proportional change in the outcome) induced by the predictor. *95% HDI does not overlap with 0.

Evacuees who Returned to Karelia *[N= 17,333]*

Model	**Predictor**	**Mean**	**5% HDI**	**95% HDI**
Factors affecting the probability of intermarriage	Intercept*	0.66	0.30	1.01
	Male*	-0.08	-0.14	-0.02
	Age*	-0.10	-0.10	-0.10
	Hypergamy*	0.10	0.05	0.15
	Population of birthplace	-0.03	-0.36	0.30
	Education*	0.35	0.23	0.47
	Agriculture*	-0.50	-0.78	-0.20
	Technical professions*	0.60	0.30	0.93
	Factory workers	0.15	-0.14	0.45
	Service industry	0.31	0.02	0.63
	Office workers*	0.64	0.32	0.97
	Business workers	0.18	-0.14	0.49
	Transportation industry	0.09	-0.22	0.41
	Married after 1945*	2.12	1.99	2.24
	Married after 1945 X Male*	-0.98	-1.12	-0.84
	Married after 1945 X Hypergamy*	0.13	0.03	0.23
Factors affecting reproductive outcomes	Intercept*	1.09	0.92	1.27
	Male	-0.01	-0.03	0.00
	Age*	0.01	0.01	0.01
	Hypergamy*	-0.04	-0.06	-0.02
	Intermarriage*	0.02	-0.02	0.05
	Population of birthplace	-0.08	-0.30	0.13
	Education	-0.02	-0.07	0.03
	Agriculture*	0.15	0.03	0.29
	Technical professions*	-0.15	-0.30	-0.01
	Factory workers*	-0.14	-0.27	-0.01
	Service industry*	-0.13	-0.27	0.00
	Office workers*	-0.23	-0.37	-0.08
	Business workers*	-0.21	-0.35	-0.07
	Transportation industry*	-0.17	-0.32	-0.03
	Married after 1945*	-0.27	-0.33	-0.22
	Married after 1945 X Male	0.11	0.06	0.16
	Intermarriage X Male	-0.01	-0.04	0.03
	Intermarriage X Married after 1945*	0.09	0.04	0.14
	Intermarriage X Hypergamy	0.00	-0.04	0.03

Evacuees who Remained in Western Finland *[N= 9,424]*				
Model	**Predictor**	**Mean**	**5% HDI**	**95% HDI**
Factors affecting the probability of intermarriage	Intercept*	0.55	0.11	0.97
	Male*	-0.37	-0.46	-0.28
	Age*	-0.08	-0.08	-0.07
	Hypergamy*	0.07	0.01	0.14
	Population of birthplace	0.32	-0.13	0.75
	Education*	0.41	0.27	0.56
	Agriculture	0.05	-0.29	0.41
	Technical professions*	0.60	0.22	0.98
	Factory workers*	0.33	-0.02	0.67
	Service industry*	0.45	0.09	0.83
	Office workers*	0.60	0.22	0.98
	Business workers	0.17	-0.19	0.56
	Transportation industry*	0.34	-0.04	0.71
	Married after 1945*	1.44	1.26	1.62
	Married after 1945 X Male*	-0.51	-0.71	-0.29
	Married after 1945 X Hypergamy*	0.13	0.01	0.26
Factors affecting reproductive outcomes	Intercept*	0.92	0.75	1.08
	Male	0.01	-0.02	0.04
	Age*	-0.01	-0.01	0.00
	Hypergamy	0.00	-0.03	0.02
	Intermarriage*	0.00	-0.05	0.05
	Population of birthplace	0.02	-0.14	0.18
	Education	0.02	-0.02	0.06
	Agriculture*	0.43	0.29	0.56
	Technical professions	0.13	-0.01	0.26
	Factory workers	0.03	-0.09	0.17
	Service industry	0.10	-0.04	0.23
	Office workers	-0.05	-0.19	0.10
	Business workers	-0.08	-0.23	0.05
	Transportation industry	0.01	-0.12	0.16
	Married after 1945*	-0.39	-0.45	-0.32
	Married after 1945 X Male*	0.09	0.03	0.14
	Intermarriage X Male	-0.03	-0.07	0.02
	Intermarriage X Married after 1945*	0.17	0.12	0.23
	Intermarriage X Hypergamy*	0.04	0.02	0.07

Supplementary Table 3: Parameter estimates and 95% highest density intervals (HDI's) for all predictors subdivided by evacuees who returned to Karelia between the wars(top panel) and evacuees who remained in western Finland throughout the war (bottom panel). Parameter estimate means and HDI's are for the relative effect (i.e. the proportional change in the outcome) induced by the predictor. *95% HDI does not overlap with 0.

ALL EVACUEES WHO WERE MARRIED BEFORE 1945				
Evacuees who Returned to Karelia *[N= 14,326]*				
Model	**Predictor**	**Mean**	**5% HDI**	**95% HDI**
Factors affecting the probability of intermarriage	Intercept*	0.94	0.41	1.43
	Male*	0.15	0.07	0.24
	Age*	-0.12	-0.13	-0.11
	Hypergamy*	0.14	0.06	0.22

	Population of birthplace	-0.27	-0.77	0.23
	Education*	0.37	0.12	0.62
	Agriculture*	-0.78	-1.19	-0.37
	Technical professions*	0.52	0.04	1.00
	Factory workers	-0.09	-0.50	0.34
	Service industry	-0.07	-0.51	0.37
	Office workers*	0.77	0.27	1.25
	Business workers	0.15	-0.30	0.64
	Transportation industry	-0.14	-0.60	0.34
Factors affecting reproductive outcomes	Intercept*	1.02	0.82	1.22
	Male*	-0.02	-0.03	0.00
	Age*	0.01	0.00	0.01
	Hypergamy*	-0.04	-0.06	-0.02
	Intermarriage*	-0.04	-0.06	-0.02
	Population of birthplace	-0.04	-0.27	0.21
	Education	-0.05	-0.12	0.02
	Agriculture*	0.20	0.05	0.34
	Technical professions	-0.15	-0.31	0.02
	Factory workers	-0.08	-0.23	0.06
	Service industry	-0.07	-0.22	0.08
	Office workers*	-0.25	-0.41	-0.08
	Business workers*	-0.14	-0.30	0.02
	Transportation industry	-0.14	-0.30	0.02
	Transportation industry	-0.14	-0.30	0.02
	Intermarriage X Male	-0.01	-0.05	0.03
	Intermarriage X Hypergamy	-0.03	-0.07	0.01

Evacuees who Remained in Western Finland *[N= 6,808]*

Model	Predictor	Mean	5% HDI	95% HDI
Factors affecting the probability of intermarriage	Intercept*	0.72	0.24	1.23
	Male*	-0.36	-0.45	-0.27
	Age*	-0.08	-0.09	-0.08
	Hypergamy*	0.08	0.02	0.15
	Population of birthplace	0.29	-0.21	0.76
	Education*	0.46	0.29	0.63
	Agriculture	-0.04	-0.47	0.34
	Technical professions	0.63	0.18	1.05
	Factory workers	0.23	-0.17	0.64
	Service industry*	0.34	-0.08	0.75
	Office workers*	0.49	0.05	0.93
	Business workers	0.06	-0.37	0.49
	Transportation industry	0.15	-0.26	0.62
Factors affecting reproductive outcomes	Intercept*	0.93	0.73	1.12
	Male	0.00	-0.02	0.02
	Age	-0.01	-0.02	0.00
	Hypergamy	0.01	-0.01	0.03
	Intermarriage*	-0.11	-0.13	-0.08
	Population of birthplace	0.10	-0.08	0.28
	Education	0.05	-0.01	0.10
	Agriculture*	0.39	0.23	0.55
	Technical professions	0.03	-0.14	0.20
	Factory workers	0.00	-0.16	0.16
	Service industry*	0.03	-0.14	0.19
	Office workers	-0.10	-0.28	0.06
	Business workers	-0.14	-0.31	0.03
	Transportation industry	-0.05	-0.22	0.12
	Intermarriage X Male	-0.02	-0.07	0.02
	Intermarriage X Hypergamy	0.02	-0.02	0.05

ALL EVACUEES WHO WERE MARRIED AFTER 1945

Evacuees who Returned to Karelia *[N= 3,007]*

Model	Predictor	Mean	5% HDI	95% HDI
Factors affecting the probability of intermarriage	Intercept*	3.30	2.68	3.97
	Male*	-1.20	-1.37	-1.03
	Age*	-0.05	-0.06	-0.04
	Hypergamy	0.05	-0.08	0.17
	Population of birthplace	0.02	-0.50	0.55
	Education*	-0.53	-0.87	-0.19
	Agriculture	-0.09	-0.61	0.44
	Technical professions*	0.60	0.00	1.23
	Factory workers	0.12	-0.41	0.66
	Service industry	0.56	-0.06	1.16
	Office workers	0.24	-0.41	0.85
	Business workers	0.12	-0.49	0.72
	Transportation industry	-0.02	-0.61	0.58
Factors affecting reproductive outcomes	Intercept*	1.14	0.82	1.46
	Male*	0.09	0.05	0.13
	Age	-0.01	0.00	0.00
	Hypergamy*	-0.11	-0.18	-0.05
	Intermarriage	0.17	0.05	0.27
	Population of birthplace	-0.07	-0.32	0.29
	Education	0.03	-0.06	0.12
	Agriculture	0.06	-0.21	0.33
	Technical professions	-0.15	-0.44	0.13
	Factory workers	-0.24	-0.51	0.03
	Service industry	-0.26	-0.53	0.03
	Office workers	-0.23	-0.52	0.06
	Business workers*	-0.30	-0.59	-0.02
	Transportation industry	-0.25	-0.53	0.04
	Intermarriage X Male	-0.04	-0.16	0.06
	Intermarriage X Hypergamy*	0.10	0.02	0.18

Evacuees who Remained in Western Finland *[N= 2,616]*

Model	Predictor	Mean	5% HDI	95% HDI
Factors affecting the probability of intermarriage	Intercept*	2.44	1.80	3.05
	Male*	-0.85	-1.04	-0.66
	Age*	-0.05	-0.06	-0.04
	Hypergamy*	0.13	0.02	0.24
	Population of birthplace	0.52	-0.07	1.08
	Education	0.20	-0.07	0.46
	Agriculture	0.28	-0.21	0.70
	Technical professions	0.44	-0.06	0.95
	Factory workers	0.46	-0.02	0.89
	Service industry*	0.66	0.16	1.20
	Office workers*	0.84	0.28	1.41
	Business workers	0.36	-0.16	0.92
	Transportation industry*	0.61	0.19	1.10
Factors affecting reproductive outcomes	Intercept*	1.16	0.88	1.43
	Male*	0.10	0.05	0.14
	Age	-0.02	-0.02	-0.02
	Hypergamy	-0.03	-0.09	0.04
	Intermarriage*	0.22	0.09	0.33
	Population of birthplace	-0.20	-0.42	0.03
	Education	-0.05	-0.12	0.03
	Agriculture*	0.49	0.27	0.71
	Technical professions*	0.28	0.05	0.50
	Factory workers	0.06	-0.15	0.29
	Service industry*	0.23	0.00	0.45
	Office workers	0.05	-0.19	0.28

Business workers	0.05	-0.19	0.29
Transportation industry	0.13	-0.09	0.36
Intermarriage X Male	0.00	-0.13	0.14
Intermarriage X Hypergamy	0.05	-0.03	0.12

Supplementary Table 4: Parameter estimates and 95% highest density intervals (HDI's) for predictors for evacuees who married before 1945 (upper half) and after 1945 (bottom half) grouped by evacuees who returned to Karelia during the war (top panel in each section) and evacuees who remained in western Finland throughout the war (bottom panel in each section). Parameter estimate means and HDI's are for the relative effect (i.e. the proportional change in the outcome) induced by the predictor. *95% HDI does not overlap with 0.

MARRIED BEFORE 1945 *[N=21,134]*

	Married a Karelian	Married a Resident Finn	Percent
INTERMARRIAGE	16,045	5,089	24%
RETURNED TO KARELIA	**Returned to Karelia**	**Remained in Finland**	**Percent**
	14,326	6,808	68%
NUMBER OF CHILDREN			
	Married a Karelian (N)	**Married a Finn (N)**	**Difference**
Returned to Karelia	3.63 (12,013)	3.02 (2,313)	+0.61
Remained in Finland	3.18 (4,032)	2.70 (2,776)	+0.48

MARRIED AFTER 1945 *[N=5,623]*

	Married a Karelian	Married a Resident Finn	Percent
INTERMARRIAGE	1,388	4,235	75%
RETURNED TO KARELIA	**Returned to Karelia**	**Remained in Finland**	**Percent**
	3,007	2,616	53%
NUMBER OF CHILDREN			
	Married a Karelian (N)	**Married a Finn (N)**	**Difference**
Returned to Karelia	2.60 (768)	2.60 (2,239)	0.00
Remained in Finland	2.23 (4,032)	2.37 (620)	-0.14

Supplementary Table 5: Descriptives statistics for all evacuees used in the models subdivided by individuals who were married before 1945 (top panel) and individuals who married after 1945 (bottom panel). Counts and percentages of evacuees who married out (i.e. married a non Karelian), counts and percentages of evacuees who returned to Karelia between the wars, the mean number of children produced by individuals who married in and married out and the mean number of children produced by evacuees who returned to Karelia and those who remained in western Finland with SE of differences.

	Membership in Karjalaseura		
	Yes	**No**	**Percent**
Returned to Karelia	8,627	4,670	64%
Married a Karelian	8,248	5,472	60%

Supplementary Table 6: The proportion of members and non-members in Karelian cultural society who returned to Karelia between 1941 and 1944 and married into the host population.

HYPERGAMY			
Before the war	**Married down**	**Married same**	**Married up**
Married a Karelian	12% [N=1874]	77% [N=12,322]	11% [N=1,849]
Married a resident Finn	22% N=1,098]	54% [N=2,750]	24% [N=1,241]
After the war			
Married a Karelian	24% [N=342]	58% [N=810]	17% [N=236]
Married a resident Finn	24%[N=1030]	52% [N=2227]	24% [N=978]

Supplementary Table 7: Proportion of evacuees who married Karelians and resident Finns who were lower, higher and of equal social status both before and after the war.

[Married before 1939]	Married Returned	Number of Children	Age at first marriage	Age at first reproduction	Percent of total
Males	Married a Karelian	3.28	26.78	28.69	74.1%
	Married a Finn	2.78	27.83	29.64	25.9%
	Returned to Karelia	3.17	27.00	28.90	57.5%
	Remained	2.67	27.23	29.17	42.5%
Females	Married a Karelian	3.29	23.79	25.40	73.3%
	Married a Finn	2.70	24.68	26.53	26.7%
	Returned to Karelia	2.94	23.67	25.56	57.5%
	Remained	2.47	24.49	26.26	43.5%
[Married after 1945]	**Married Returned**	**Number of Children**	**Age at first marriage**	**Age at first reproduction**	**Percent of total**
Males	Married a Karelian	2.49	32.71	30.66	32.5%
	Married a Finn	2.50	31.77	30.23	67.5%
	Returned to Karelia	2.67	31.60	30.15	44.7%
	Remained	2.40	32.66	30.80	55.3%
Females	Married a Karelian	2.48	31.36	28.12	36.8%
	Married a Finn	2.43	30.56	28.03	63.2%
	Returned to Karelia	2.48	30.98	28.10	58.5%
	Remained	2.34	32.47	28.46	41.5%

Supplementary Table 8: Mean number of children, age at first marriage, age at first birth and percentage of population who a) married a Karelian, b) married a resident Finn, c) returned to Karelia and d) remained in western Finland for both males and females subdivided between evacuees who were married before 1939 (top panel) and evacuees who were married after 1945 (bottom panel)

Complete Cohort Fertility estimates					
Cohort birth years	**Karelian evacuees**	**Human LH Group**	**Statistics Finland**	**Human Fertility**	**Lindgren dissertation**
1890-1939	2.67	2.64	2.91	NA	NA
1890-1930	2.69	2.72	2.85	NA	NA
1905-1926	2.62	2.66	2.82	NA	2.56
1924-1930	2.63	2.53	2.82	2.53	NA

Complete Cohort Fertility estimates and percentage of population by occupation 1890-1939				
Occupation	**Karelian evacuees**	**Karelian evacuees %**	**Human LH Group**	**Human LH Group %**
Farmers	3.43	27%	3.88	14%
Non-farmers	2.41	73%	2.44	86%

Supplementary Table 9: Complete cohort fertility (CCF) estimates (top panel) for the Karelian evacuees, the Human Life History (LH) Group (non Karelian parishes only), Statistics Finland and The Human Fertility database (all of pre 1939 Finland)[61] include all births recorded to women who lived to at least age 44. The estimates from Statistics Finland [62] were generated by using preadjusted 'normal period rate' estimates [62] and adjusting them by the mean age at birth for women from each birth cohort (e.g. the average year a woman born in 1890 gave birth was 1915) and the estimates from the Lindgren dissertation were compiled using 2 year moving averages for all of pre 1939 Finland see [63]. Fertility rates by occupation (bottom panel) were obtained using the same categories of agricultural workers listed for the Karelian evacuees and for individuals in the Human Life History Group's genealogical data. The complete cohort fertility estimates for the 'Karelian evacuees' and the 'Human Life History Group' (non Karelian parishes only) are for all births of individuals born between 1890 and 1939. They include all births recorded for women who lived to at least age 44. Fertility rates by occupation were obtained using the same categories of agricultural workers listed for the Karelian evacuees and for individuals in the Human Life History Group's genealogical data but do not constitute a complete subset because only the occupations for which individuals in the Human Life history group and the Karelian evacuees could be exactly matched were used for the 'Farmers' and 'Non-farmer' categories. The comparison between the Karelian evacuees and the Human Life History group data in the bottom panel is the best and most direct comparison because it allows for a comparison between the fertility rates of non-Karelian Finns and Karelian Finns. The other datasets combine all Finns together. In addition, because the main difference in fertility rates in our data is between agricultural and non-agricultural workers the life history group estimates are the only estimates that permit us to subdivide the data by whether or not individuals were farmers.

	Returned X Sex	Returned X Age	Returned X Married after	Married after X Sex	[Married after*Hypergamy]	WAIC	pWAIC	Weight
Intermarriage Models	X	X	X	X	X	24380	47.4	1
	X	X	—	X	X	24379	46.2	0
	—	X	X	—	—	24413	45.2	0
	X	—	—	—	—	24473	45.4	0
	—	—	—	—	—	24511	44.2	0

	Returned X Sex	Returned X Age	Returned X Married after	Married after X Sex	[Intermarriage X Sex]	[Intermarriage X Returned]	[Intermarriage X Married after 1945]	[Intermarriage X Hypergamy]	WAIC	pWAIC	Weight
Reproductive Outcome Models	X	X	X	X	X	X	X	X	116810	104.7	0.55
	X	X	X	—	X	X	X	X	116813	103.2	0.45
	X	X	X	—	X	—	X	—	116835	100.8	0
	X	X	X	X	—	—	—	—	116864	98.5	0
	—	X	—	X	X	X	—	X	116877	101.5	0
	X	X	—	X	—	—	—	—	116893	97.2	0

Supplementary Table 10: Model comparisons between top ranked models (see Supplementary materials Model selection to see which variables entered into which models). Table shows the Watanabe-Akaike information criterion (WAIC) scores, the number of effective parameters (pWAIC) and model weights for each model with the respective interactions entered or left out.

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