Self sacrifice and kin psychology in war: threats to family predict decisions to volunteer for a women's paramilitary organization

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ABSTRACT

The conditions that propel humans to make sacrifices for groups of unrelated, and often unknown, individuals has received considerable attention across scientific disciplines. Evolutionary explanations for this type of sacrifice have focused on how men form strategic coalitions organized around kin networks and reciprocity when faced with out-group threats. Few studies, however, have analyzed how women respond to external threats. Using data from one of the largest female paramilitary organizations in history we show that women who have more brothers, women whose husbands serve in the military and women without children are more likely to volunteer. These results provide qualified support for the hypothesis that women are more likely to sacrifice for their country when members of their family are at risk. Overall, our analysis suggests that self-sacrifice and intense bonding with an imagined community of unknown individuals, such as the nation state, may arise out of a suite of psychological adaptations designed to facilitate cooperation among kin (i.e. kin psychology). These results can be interpreted within the framework of kin selection showing how individuals come to view unrelated group members as family. They may also shed light on various theories of group alignment, such as 'identity fusion' – whereby individuals align their personal identity and interests with those of the group – and on our understanding of evolutionary adaptations that cause women to direct altruism toward in-groups.

1. Introduction

Researchers have long puzzled over which conditions are most likely to trigger self sacrifice when individuals are threatened by outside groups. Theories that are based on the evolutionary forces expected to generate altruistic behaviors, such as kin selection (Hamilton, 1964) or reciprocal altruism (Robert, 1971), are unable to fully explain the extent of this phenomenon. Common explanations for why people are so often willing to sacrifice for large groups of unrelated, and often unknown, individuals have typically focused on cultural adaptations which harness kin psychology (Carsten, 1995; Carsten, 2000; Clarke, 2008; Henrich, 2015; McNamara & Henrich, 2017) — a suite of cognitive and psychological mechanisms that direct our interactions with genetic relatives (Fessler & Navarrete, 2004; Lieberman, Tooby, & Cosmides, 2007). For example, applying kinship terminology (e.g. a 'band of brothers') to unrelated individuals (Henrich, 2015) may trigger emotional responses similar to those activated by actual genetic relatedness which may further serve to bond individuals with larger groups (Richerson & Henrich, 2009). If ancestral human groups were composed primarily of closely related individuals, (Lieberman et al., 2007)

then a shared culture, background or belief system may have served as a reliable phenotypic marker of kinship by signaling genetic relatedness (Park & Schaller, 2005; Swann et al., 2014).

Theories on group identification in humans have historically focused on relationships between individuals that involve allegiance to the group or what are called collective ties (Tajfel, Turner, Austin, & Worchel, 1979; Vázquez, Gómez, & Swann, 2017). Building on these ideas, Swann and Gomez (Swann, Jr, Seyle, Morales, & Huici, 2009) developed the theory of 'identity fusion' and argued that extreme self sacrifice results when individuals align their own identity with that of the group. This can occur through bonding over intense shared experiences (e.g. the horrors of war) (Whitehouse & Lanman, 2014) or from perceptions of shared biology (e.g. phenotypic matching) (Swann et al., 2014). However, unlike previous theories of group identity, fusion theory predicts that strongly fused persons will align themselves, not only with the group category, but also with the individual members of the group, who they may come to view as family. In other words fused individuals will show the same visceral commitment they express to people they know personally, to individuals whom they have never met. Therefore an important difference between theories of social

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identity and identity fusion is in the importance they place on attachments to fellow group members vs. allegiance to the group as a whole. While theories of group identification tend to focus on the ties that bond individuals to groups independent of one's interpersonal relationships (i.e. collective ties) (Brewer & Gardner, 1996; Prentice, Miller, & Lightdale, 1994), identity fusion places an equal emphasis on the specific relationships between individuals (i.e. relational ties) (Vázquez et al., 2017). These connections create a visceral feeling that members of one's group are kin (Swann, Jetten, Gómez, Whitehouse, & Bastian, 2012) and is expected to be particularly potent when combined with a strong outgroup threat (Bernhard, Fischbacher, & Fehr, 2006; Choi & Bowles, 2007; Gómez, Morales, Hart, Vázquez, & Swann Jr, 2011; Swann et al., 2014; Swann, Jr, Huici, Morales, & Hixon, 2010; Whitehouse & Lanman, 2014). Studies have shown that viewing fellow country men as kin increases willingness to make sacrifices for them especially in the presence of a strong outgroup threat (Buhrmester, Fraser, Lanman, Whitehouse, & Swann Jr, 2015). For example, violence among football fans is predicted by the degree to which they view fellow fans as family members (Newson et al., 2018). Together, however, these theoretical arguments and empirical findings suggest that extreme self-sacrifice can be made possible by exploiting psychological pathways dedicated to kin-biased altruism (Atran & Gómez, 2018).

Although theories of social identity and group alignment that generate specific predictions about when we should expect individuals to sacrifice for the collective have been tested in a variety of experimental and empirical contexts, some important limitations have prevented researchers from drawing broad conclusions. First, most field studies and anthropological research has focused on men (Atran, Sheikh, & Gomez, 2014; Chagnon, 1988; Goldschmidt, 1988; Macfarlan, Walker, Flinn, & Chagnon, 2014). This is often due to a view that women are either passive agents during intergroup conflicts or reproductive resources over which male dominated groups compete (Chagnon, 1988; Trivers, 1972). Ignoring the interests of women in these contests is surprising, however, especially given the well-established differences in the fitness interests between males and females (Chapman, Arnqvist, Bangham, & Rowe, 2003; Trivers, 1972; Williams, 1966) which are also expected to play an important role in how men and women respond to outgroup threats (Melissa, McDonald, & Van Vugt, 2012; Navarrete, McDonald, Molina, & Sidanius, 2010; Van Vugt, 2009). For example, men are seen to respond more strongly to intergroup threats (Van Vugt, 2009) and engage in riskier forms of 'heroic' helping (Alice, 1986) than women. Although women seem to have a much higher threshold for engaging in intergroup violence overall (Van Vugt, 2009), some have argued that these responses are context specific and are likely to reflect evolved mating and parenting strategies (Trivers, 1972). For instance, some researchers have argued that women may be more motivated to cooperate with ingroups in the face of out-group threats when the danger of sexual coercion is high (Melissa et al., 2012) while others have suggested that females may be more likely to employ a more affiliative strategy with outgroup males when there is a perceived threat to their children (Melissa et al., 2012; Taylor et al., 2000). A study of suicide bombers, for example, showed that men are more motivated by religion or nationalism while women were more likely to be motivated by personal factors such as by revenge or feeling socially isolated (Jacques & Taylor, 2008). Second, detailed pedigrees and records of altruism are crucial for testing how kinship might motivate decisions to sacrifice for the collective in either sex, but there are few datasets in existence which contain the reproductive histories, marriages and records of altruistic self sacrifice of an entire population across multiple generations.

Here, we use an unusually well-documented dataset recording the lives of evacuees from Finnish Karelia during World War II to test which factors are positively associated with the likelihood that women volunteer for a woman's paramilitary organization called Lotta Svärd (Nevala-Nurmi, 2006; Ollila, 1995). On November 30th, 1939 the Soviet Union invaded Finland, marking the beginning of the Winter War

and the Karelian population fled to western Finland, although approximately 60% of these evacuees returned to Karelia when it was temporarily recaptured by Finland between 1942 and 1944 (see Supplementary Materials: The evacuation of Karelia). Many Karelian women joined the Lotta Svärd organization which was tasked with supporting troops as nurses, air raid spotters, mess personnel and in other auxiliary capacities. By 1944 it included 221,000 volunteers, approximately 10% of the female population of Finland (Ollila, 1995). Volunteers in our data ranged in age from 7 to 65 years old and were recruited from a variety of family contexts (e.g. single, married, husband served in the war, sisters, brothers, sons and daughters). The different backgrounds and the strictly voluntary nature of participation (Pohls & Latva-Äijö, 2009) in the organization allows us to test some key hypotheses generated by kin psychology in women.

Theoretical arguments predicated on evolutionary theory, kinship psychology and identity fusion make specific predictions about which conditions are most likely to elicit bonding with large extended groups and to encourage sacrifice (Melissa et al., 2012; Swann et al., 2012; Whitehouse, 2018). If in the face of a serious threat from an outgroup, a willingness to sacrifice is enhanced by feelings of a shared essence with one's ingroup — either due to the perception of shared biology or shared experiences — then we should expect that Lotta Svärd volunteers will be motivated by a feeling of heightened danger when their actual kin and families are at risk. Therefore, we predict: P1) that unmarried women without children will be more likely to volunteer if they have brothers, but not sisters, because their brothers will be more exposed to dangers at the front; P2) women who are already married when the war begins will be more likely to volunteer if their husbands are actively serving in the military and are therefore more exposed to risks at the front; P3) women who have young children in whom they are already heavily invested will be less inclined to put themselves at risk and will therefore be less likely to volunteer. Because these data were collected from a refugee population, we also seek to analyze some of the factors which mark individuals as being more assimilated into the host population. We hypothesize that more culturally assimilated women will have a greater sense of shared essence with Finland and predict that P4a) Karelians who marry resident Finns and P4b) those who remain in western Finland throughout the war will be more bonded to their country and will therefore be more likely to volunteer for Lotta Svärd.

2. Methods

2.1. Pre-registration

All methods and statistical analyses were pre-registered on May 23, 2018, prior to our accessing and analyzing these data. The predictor variables, outcome variables, model selection criteria and proposed analyses outlined below are the same as those identified in the Open Science Framework pre-registration (Lottas, n.d.) (see Supplementary materials: Pre-registration for additional details).

2.2. Data

Structured interviews of Finnish evacuees during World War II were published in a four volume set called'Siirtokarjalaisten tie' (Anon, 1970). The project was part of an effort to record the lives of the people who were forced to evacuate from eastern Finland during World War II. Over 300 individuals were trained to conduct these interviews which took place between 1968 and 1970 and an effort was made to locate all people who were evacuated during the war. Each entry in the published books lists the name, sex, date of birth, birthplace, occupation, year of marriage, spouse, husbands service records and membership in various organizations of both husband and wife including Lotta Svärd. To determine the percentage of people who reported their Lotta Svärd service during interviews, we compared handwritten service records available

at Finland's National Archives, with the accounts recorded in these registers. In a random sample of 30 records accessed in alphabetical order, we found that 24 of them (80%) had reported their service. The books were scanned and software was developed (Kaira Core and Natural Language Processing (NLP) software designed for use with the Finnish language) to digitize and extract these records (see (Loehr et al., 2017) for a more in depth presentation of data extraction methods and the construction of the MiKARELIA database). Overall there are data on approximately 250,000 individuals, including children and spouses, but here we focus on a subset of 78,117 women — 9078 of whom were listed as being members of Lotta Svärd. We extracted the name, year of birth, occupation, potential husband's name, husband's potential war service records and the mention of membership in Lotta Svärd for all women listed who were alive when the Soviet Union invaded.

To obtain an individual's number of brothers and sisters, we linked individuals in these books by their full names and exact day of their birth to additional information recorded in a recently digitized public database containing all individuals living in the annexed territories of Karelia (Katiha database, n.d.). These data were recorded by the Finnish Lutheran and Orthodox Churches and contain information on family size and composition but are only available for individuals born before 1920. For these analyses we extracted the number of brothers and sisters that individuals had from these data and were able to reliably link 5784 to women listed in the 'Siirtokarjalaisten tie' books.

2.3. Lotta Svärd and the war

Lotta Svärd organization was a paramilitary organization for women that operated in Finland from 1920 to 1944 and has been credited with playing a crucial role in countering the Soviet invasion. While military service for able bodied men was compulsory during World War II, serving in Lotta Svärd was completely voluntary. Before the war adult members had to be at least 17 years old, have recommendations from two people within the organization and be of "good moral standing". During the war the requirement for references was dropped due to the high demand for new members and adult membership increased from 105,023 in 1939 to 172,755 (i.e. approximately 14% of the women who were eligible to serve) by the end of 1943. The youth corps was created in 1931 for children aged 8–16, with 14–16 year olds taking on duties with greater responsibility. In total, there were 221,613 volunteers in the adult and youth corps by the end of the war (Pohls & Latva-Äijö, 2009).

The commencement of hostilities in 1939 was a turning point for the Finnish nation which was still suffering from the extraordinarily divisive effects of the 1917 civil war. The country quickly united under the common goal of repelling the Soviet Union and the Winter War (1939–1940) is widely considered to have played an important role unifying the country (Tuunainen, 2016). For women the motivation for joining Lotta Svärd varied but some of the most commonly cited reasons were a desire to help soldiers in need, a sense of duty to help others, the desire to defend the nation and a feeling of belonging (Olsson, 2005). Upon joining the organization, new members were sworn in by pledging allegiance to 'Home, Faith and Fatherland' and their duties included nursing, mess, anti-aircraft spotting, fundraising, office and messenger activities (Pohls & Latva-Äijö, 2009). These duties were performed either on the home front or at the front lines where approximately 40% of Lottas served.

Despite the potential dangers of serving close to the front, Lotta mortality was relatively low during the war, although Lottas would have been unlikely to know this prior to joining. A total of 116 women were killed or went missing at the front or died in bombing raids on the home front, another 140 died of illnesses contracted while on duty and 34 died in accidents (Pohls & Latva-Äijö, 2009). The organization was disbanded on November 23, 1944 as a stipulation of the Moscow Armistice (Kemppainen, 2005).

2.4. Statistical analysis

To analyze the likelihood of volunteering for Lotta Svärd (yes vs no) we used a GLMM regression in R Studio 3.3.3. Model fitting was performed using a Hamiltonian Monte Carlo algortithm, implemented in version 2.12 of Stan41, to draw samples from the posterior distribution. We assessed convergence by inspection of the trace plots, Gelman–Rubin R̂, and an estimate of the effective number of samples. We used Bayesian inference for all statistical analyses. In a Bayesian framework, each model conditions data on prior probability distributions and uses Monte-Carlo methods to generate posterior distributions for the parameters. The priors are the initial probabilities for each possible value of each parameter. This type of analysis allows us to compare posterior distributions across occupational categories, age groups and marriage types without relying on specific post-hoc tests (McElreath, 2015) while making the need to adjust for multiple comparisons unnecessary (Gelman, Hill, & Yajima, 2012). We are also better able to visualize and interpret differences between parameter estimates relative to a specific value by reporting and displaying the entire posterior distribution for each predictor and showing the highest density intervals (HDI) to reveal the most credible values for each parameter estimate. Here we assume that 95% highest density intervals which do not include zero are evidence that the parameter value is credibly different from the baseline.

To analyze which factors predict the probability of volunteering for Lotta Svärd we developed two models each of which accessed different subsets of the data. These models used different datasets because information on an individual's number of siblings was only available for some of the women (see Data). In the first model (Fig. 1, Fig. 3 and Supplementary materials Table S1 - top panel) we used data on all individuals who we were able to link to their siblings in another genealogical dataset complied by the Finnish Orthodox and Lutheran churches. This sample included women who were between the ages of 21 and 62, with a median age of 29 years old when the war began (we only
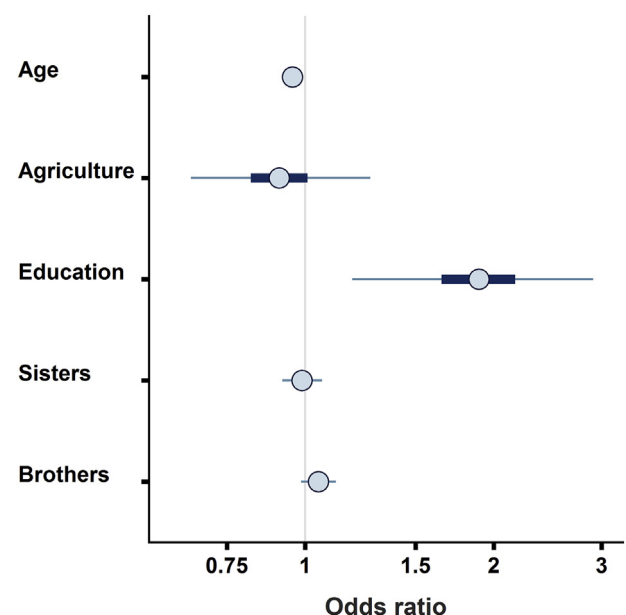
Fig. 1. Women who were at least 18 years old, unmarried and had not yet had any children when the Soviet Union invaded in 1939. Younger women and farmers are slightly less likely to volunteer for Lotta Svärd while more educated women and those with more brothers are more likely to volunteer. Plots of uncertainty intervals computed from posterior draws with all chains merged. The 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 S1- upper panel for median estimates and 95% HDI's for all parameters included in this model.

had sibling data on individuals born before 1920: see Data), were unmarried and had not yet had any children when the war ended (N = 5784). This model was designed to analyze the effect of having brothers (P1) on the likelihood of volunteering for Lotta Svärd for all unmarried women without children. The total number of brothers and total number of sisters were entered as continuous predictor variables and were used to analyze the impact of brothers on the likelihood of volunteering. The outcome variable was Lotta Svärd service (0 = no [N = 4611], 1 = yes [N = 1173]). The following control variables were also entered: age in 1940, current occupation involving agriculture (0 = no [N = 4385], 1 = yes [N = 1399]) and current occupation requiring education (0 = no [N = 5287], 1 = yes[N = 497]). Education was chosen because social status may have played a role in the likelihood of volunteering for Lotta Svärd (Nevala-Nurmi, 2006) and agriculture was included because the production of food was a priority of the Finnish government during the war (Lavery, 2006). In addition previous analyses have shown that education and farming explain much of the variance in social status among this population (Lynch et al., 2019).

A second model was designed to analyze the effect that a husband serving in the military (P2), children(P3) and integration (P4a) and (P4b) had on Lotta Svärd service. Here we used data on a larger sample which included all women who were between the ages of 19 and 63 when the war began with a median age of 30 years old (N = 11,812). Whether their husband served in the military during the war (0 = no [N = 3454], 1 = yes [N = 8358]), total number of sons [mean = 1.44] and total number of daughters [mean = 1.36], whether they were single when the war began (0 = no [N = 8963], 1 = single [N = 2849]), whether they intermarried (0 = no [N = 7482], 1 = yes [N = 4330]) and whether they returned to Karelia during the war (0 = no [N = 5466], 1 = yes [N = 6346]) were dummy coded and entered into this model. The following control variables were also entered: age in 1940, whether their husband was injured during the war (0 = no [N = 10,721], 1 = yes [N = 1091]), current occupation involving agriculture (0 = no [N = 8137], 1 = yes [N = 3675]) and current occupation requires an education (0 = no [N = 11,281], 1 = yes [N = 531]). Whether their husband was injured during the war was included to determine if greater family sacrifice predicted the likelihood of volunteering above and beyond that of serving in the military. Candidate predictor variables were systematically entered into each model and those with the lowest Watanabe-Akaike information criterion (WAIC) scores were selected to be used in the final model(see Supplementary Materials: Model Selection).

All statistical analyses were performed in R version 3.3.2. Bayesian inference was carried out using the rstan package for R version 2.14.1 (Goodrich, Gabry, Ali, & Brilleman, 2018), an interface to Stan which uses a Hamiltonian Monte Carlo sampler. We also used the rethinking package in R version 1.59 (McElreath, 2016), which includes convenience functions for building, sampling, and summarizing models (McElreath, 2015). All code for figures analyses and exact specifications for all models are on Github (Lottas, n.d.).

2.5. Model validity, effects and specifications

To assess the validity of the models and their ability to reverse engineer the observed data, we conducted a posterior predictive check (for results see Supplementary Materials Figs. S2a–c). Bayesian models are generative whereby the posterior distributions produced by these models can be used to make specific predictions on counterfactual data. This allows for determining 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 person. This might be a woman who is the average age, has the average education, has an average occupation, has the average number

of brothers and the average number of sons for the sample used by the model to generate these predictions. Hamiltonian Monte Carlo Chains programmed in STAN were used to generate posterior distributions. We specified broad but weakly regularizing priors that tamp down the effects of extreme values: normal distributions centered on 0 for most parameters, normal distributions centered on null hypothesized isometric slopes for all continuously varying covariates, and Cauchy distributions with a shape parameter of 1 for standard deviations. Models were run with four replicate chains for 10,000 MCMC iterations with a 20% warm up.

3. Results

Overall, younger, more educated women who were employed in non-agricultural occupations and women without children under the age of 17 were more likely to volunteer for a paramilitary organization. We found support for the prediction (P1) that women who were single and did not have any children when the war began will be more likely to volunteer if they have more brothers while their number of sisters has no effect on their likelihood of volunteering (Figs. 1 and 3 and Table S1).

The model predicts that the probability of volunteering for an 'average' (see Methods: Model validity, effects and specifications) woman, who has the average number of sisters (mean = 2.42) and no brothers will increase by 18% if she has 4 brothers. At peak enrollment in 1944 (220,000 members) this increase would have meant an additional 39,600 volunteers. In contrast, a woman with the mean number of brothers (mean = 2.46) is predicted to have a similar probability of volunteering regardless of how many sisters she has (see Table 1 and Fig. 1).

We also found support for the prediction (P2) that women who were

Table 1
Model generated predictions and 95% highest density intervals (HDI's) for the impact of brothers, sisters, the military service of husbands, children, marriage and returning to Karelia on the likelihood of volunteering.

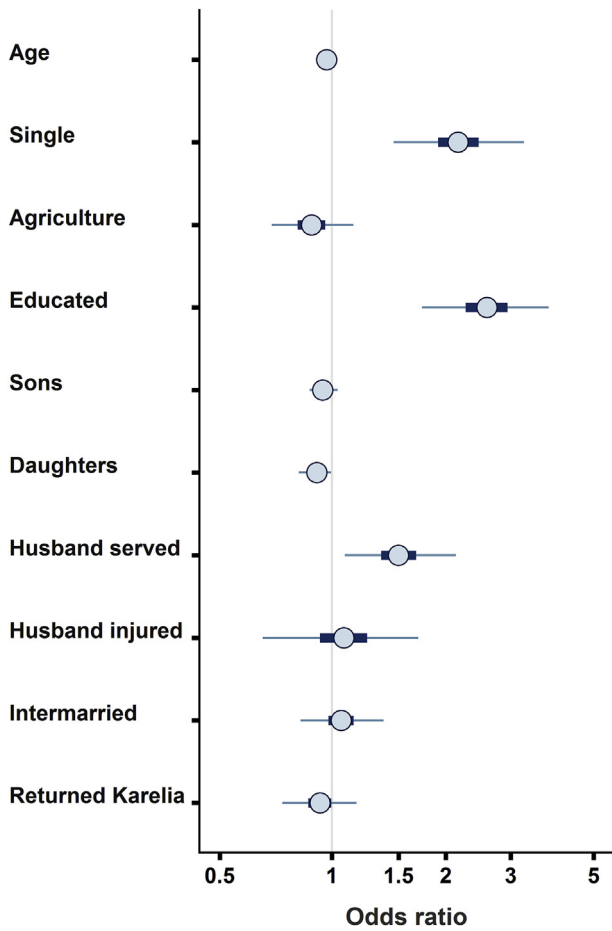| Model generated predictions				
Prediction	Siblings	Likelihood of volunteering	95% HDI	Support
P1	Brothers			
The impact of siblings	0	19.2%	17.8–20.7	✓
[N = 5784]	4	22.7%	21.4–23.8	✓
	Sisters			
	0	21.6%	20.1–23.1	–
	4	20.8%	19.4–21.3	–
P2	Husband served			
The impact of husbands	No	9.1%	17.8–20.7	✓
[N = 11,812]	Yes	13.2%	12.5–13.8	✓
P3	Children			
The impact of children	None	26.6%	23.9–29.3	✓
[N = 11,812]	≥1	10.3%	9.6–10.9	✓
	Sons			
*All children > 17 years old	0	8.9%	5.9–12.0	–
[N = 2085]	≥1	8.8%	5.8–11.9	–
P4a	Intermarried			
The impact of intermarriage	No	9.7%	9.4–10.1	✓
[N = 11,812]	Yes	11.5%	10.6–12.3	✓
P4b	Returned to Karelia			
The impact of return migration	No	10.6%	10.1–11.1	✓
[N = 11,812]	Yes	9.7%	9.2–10.2	✓

Fig. 2. Women who are unmarried and without children are more likely to volunteer if they have brothers as compared to sisters. Model generated Posterior predictions are solid lines with 80% HDI's shaded and error bars are the observed value means and standard errors. Both predicted and observed values are for the either the number of brothers or sisters (X-axis) while holding the number of opposite sex siblings at their mean (i.e. mean sisters = 2.42 and mean brothers = 2.46) (see table S1 for parameter estimates and 95% HDI's).
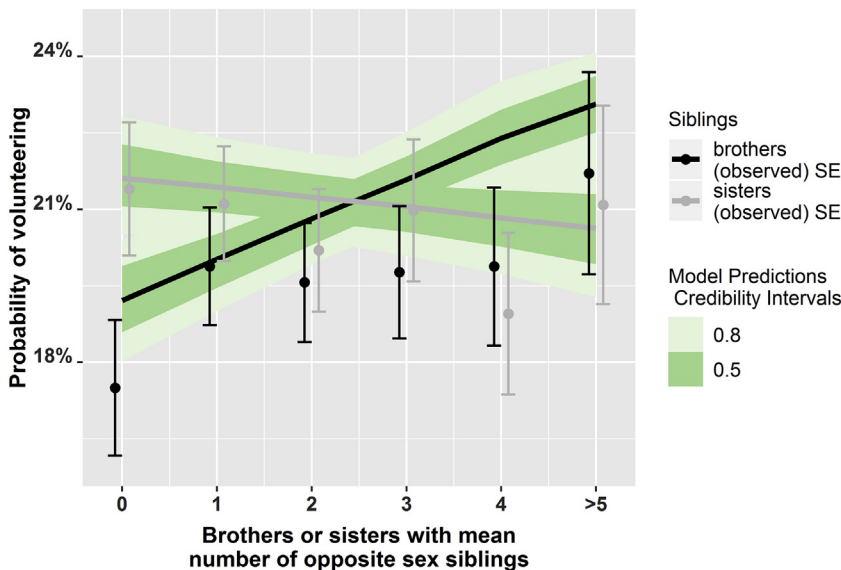
married when the war began will be more likely to volunteer for Lotta Svärd if their husbands were serving in the military (Figs. 2, 4, and Table 1 and and Table S1). The model predicts that the likelihood of a woman volunteering for Lotta Svärd if her husband serves in the military increases by 45% (see Table 1). Having children also reduces the predicted probability of a woman volunteering by more than half and there were no detectable differences between having sons vs daughters (P3) (for odds ratios and model generated predictions see Table S1, Figs. 2 and 4). Women who never got married, in comparison to single women during the war who eventually did get married were also less likely to volunteer(19.3% likely as compared to 22.8%). For married women the effects of having children and being married to someone who serves in the military are additive. The model predicts that the combined likelihood of volunteering for women who have at least one child and a husband who did not serve in the military is 7.8% (95% HDI: 6.9–8.8). This likelihood doubles for women without children and a husband who does serve to 15.8% (95% HDI: 14.6–17.0). Other variables in the model that affected the predicted probability of volunteering were working in agriculture - reduces likelihood by 1.5% (14.5% to 13.0%), having an education — more than doubles the likelihood 13.5% to 29%, being single in 1945 — double the likelihood 11.9% to 22.7%, and husband injured which had no detectable additional impact beyond the effect of having a husband who served— having a husband who served and was not injured (13.3%) vs having a husband who served who was injured (14.0%). To determine if having sons of military age would predict an increased likelihood of volunteering, in a post hoc analysis we looked at the effect of children's age on the likelihood of volunteering. Using a subset of women who all had children who were at least 17 years old (i.e. sons old enough to serve in the military) when the war began, the predicted probability of volunteering for women who had zero sons did not differ from that of a woman who had one or more sons (see Table 1; Supplementary materials: Table S1 and Fig. S1 from model generated predictions and odds ratios).

We also examined the relationship between assimilation with the host society and the likelihood of joining Lotta Svärd and found that individuals who were more integrated into the nation by 1) marrying someone from western Finland (P4a) and 2) remaining in Finland throughout the war (P4b) were also more likely to volunteer. Women who marry men from western Finland (i.e. not Karelians) and are therefore seen as more integrated into the Finnish population were 18% more likely to volunteer(see Table 1) and women who remained in western Finland throughout the war (i.e. seen as more integrated) are

Fig. 3. All women who were already married when the Soviet Union invaded in 1939 or never married. Younger women, farmers, individuals with more sons and more daughters are less likely to volunteer for Lotta Svärd. Older, more educated women and those who had a husband who served in the military and women who never marry are all more likely to volunteer for Lotta Svärd. Plots of uncertainty intervals computed from posterior draws with all chains merged. The 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 S1- upper panel for median estimates and 95% HDI's for all parameters included in this model.
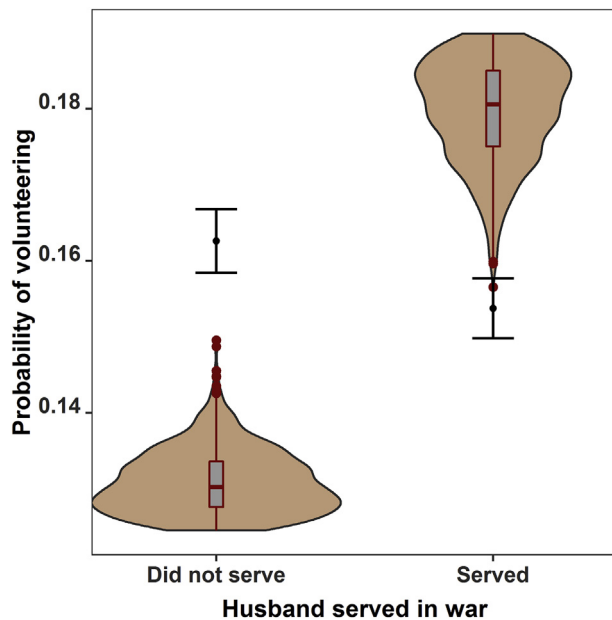
Fig. 4. Women are more likely to volunteer if their husbands serve in the military. Model generated posterior predictions are violin plots with 95% HDI's shaded and error bars are the observed value means and standard errors. Both predicted and observed values are for women whose husbands served in the military and those whose husbands did not while holding all other variables in the model at their mean value (e.g. mean age, mean education level...)(see Table S1 for parameter estimates and 95% HDI's).

predicted to be 10% more likely to volunteer than those who returned home to Karelia between the wars. Error bars and raw data scatter plots for all variables used in this study can be accessed here: Interactive-app.

4. Discussion

Kin psychology may play an important role in generating strong ingroup bonds with unknown individuals across extended and largely imagined communities (Richerson & Henrich, 2009). Meanwhile, identity fusion theory posits that strongly fused individuals will experience kin-like bonds with individuals with whom they have had little or no contact (Atran et al., 2014; Swann et al., 2009; Whitehouse, 2018) by psychologically transforming genetically unrelated members of their ingroup into kin (Swann et al., 2012). In the face of an outgroup threat of sufficient magnitude, this process is seen to hijack kin psychology by harnessing the biases toward relatives that evolved through kin selection and inducing individuals to make sacrifices for the community (Whitehouse, 2018). Forces of cultural evolution (Boyd & Richerson, 1988) are then expected to reinforce these initial biological predispositions and can select for "extended fusion", whereby individuals artificially extend family-like bonds to a much larger community (Newson, Buhrmester, & Whitehouse, 2016). Our analysis supports a central prediction made by identity fusion theory by showing that women who were more likely to have had actual family members at risk (i.e. husbands and brothers in combat) are more likely to volunteer for a paramilitary group. Taken as a whole, this study offers a rare test of how kin psychology can induce women to make sacrifices for the group and indicates that threats to family members serve to motivate women to sacrifice for unrelated members of the larger community. These results 1) add to the evidence that kin psychology plays an important role in fostering self sacrifice in humans, 2) suggests that women may have a distinct, context specific response to intergroup conflict, 3) supports the view that risk aversion and protecting kin, especially dependent children, is an important determinant of the likelihood of self sacrifice in women and 4) suggests that evacuee integration into the host society

may affect one's willingness to sacrifice for the nation.

First, these findings suggest that women are more motivated to sacrifice to protect a larger community by threats to members of their immediate family in the face of an outgroup threat adding to research (McNamara & Henrich, 2017) and theory (Richerson & Henrich, 2009) showing that kin psychology helps drive group sacrifice. Having brothers [for single women], having husbands who are serving in the military [for married women] and not having dependent children [children under 18 during the war] all predict a greater likelihood of volunteering. This indicates that the extreme sacrifices are tied to perceived threats to close kin. If one's brothers or husbands are threatened, stronger alignment and fusion with the nation may arise. Overall, these results support the hypothesis that identity fusion harnesses kin psychology to bond individuals with larger communities in the face of a sufficient outgroup threat.

Second, women may have a context specific response to outgroup threats. Although a serious outgroup threat is likely to elicit strong psychological responses in both sexes, theory predicts and experimental evidence has shown that this response is stronger and more generalized in men (Melissa et al., 2012). Women, meanwhile, may be motivated only under more specific conditions such as when they perceive threats to their close relatives. Also female reactions to outgroup threats are expected to be most pronounced when they perceive threats to their reproductive choice (Navarrete et al., 2010; Wang, Kruger, & Wilke, 2009). Importantly this sacrifice seems to occur even when the actions are unlikely to have any measurable impact on the lives of kin as women volunteering for support units (e.g. nurses, anti aircraft spotters) would almost certainly not have been able to target their aid toward specific men like husbands or brothers.

Finally, these results support research indicating that reproductive goals and current offspring are especially important factors predicting risk tolerance in women (Wang et al., 2009). These results also indicate that protecting current offspring may affect the likelihood of identity fusion in females. Women with dependent children were considerably less likely to volunteer than women without dependent children and this difference disappears for women who had sons who were over the age of 17. The reasons for the failure of the model to detect any differences between having sons vs daughters when all of the children were over the age of 17 are unclear but they may simply reflect the inability of the model to detect differences with a severely reduced sample size (i.e there were only 156 women who volunteered in that model). However, this result is consistent with the hypothesis that it is having dependent children, rather than having children in general, that influences decisions to volunteer. Taken together these results suggest that a primary goal is to protect and raise dependent kin. The fact that single women of all ages are also more likely to volunteer lends further support to this hypothesis. Sex biased parental investment is positively correlated with lifespan in primates (Allman, Rosin, Kumar, & Hasenstaub, 1998). This is commonly viewed as support for the prediction that risk taking is expected to be lower in the sex that invests more in offspring (Trivers, 1972) especially if they have current offspring to care for and protect. However, this is also expected to be true of reproductive goals in general and women who do not plan to have any children are expected to be more risk tolerant (Wang et al., 2009). Results showing that women who neither married nor ended up having any children after the war ended are less likely to volunteer support this view.

It is important to note, however, that although these analyses reveal associations between variables, they do not allow us to make inferences about causation. Indeed there are a number of plausible alternative explanations for these results. First it is possible that childless women are less interested in helping to raise their brothers children because they are less certain of their relatedness to them (i.e paternity certainty) and this may be particularly true in unstable environments such as those experienced during war. Another possibility is that women with more males in their family are simply raised in a more pro military

environment and therefore become more patriotic. In other words, if males are more likely to have a positive attitude toward the military, are more supportive of militant defense, more committed to certain values or are simply more nationalistic than women, then being exposed to these attitudes and living in a family with more males at risk may have created social pressure on women to enlist. However, it is unlikely that this explanation can fully account for women's willingness to make this sacrifice. This is because women who had husbands participating in the war were also more likely to volunteer and military service was mandatory for all males of a certain age. Because exemptions were only made for physical disabilities, but not for psychological reasons (Nevala-Nurmi, 2006), this result is unlikely to depend on a pro-military culture within the family. Nevertheless it is still possible that women with husbands who served were of a different type or were under more social pressure to volunteer than those married to men who do not serve. Furthermore, even if we accept the interpretation that threats to actual family members are behind women's decisions to volunteer, we have no evidence that these women viewed their fellow countrymen as kin or that they developed strong ties to the collective. Results showing that women with children are less likely to volunteer may be even more difficult to interpret. Perhaps the simplest explanation for why women with dependent children could not volunteer is simply because they were responsible for the care of their children and could not leave them unattended regardless of how fused or committed they were to the nation. Overall, however, it is important to note that these results are suggestive only and the nature of these data neither allow us to determine causation nor allow us to definitively rule out several plausible alternative explanations. Additional "natural experiments" with more detailed information on the volunteers would help to provide a better identification of the causal relationships suggested by these results.

Results showing that women who intermarried (i.e. married men from western Finland) and remained in the host society throughout the war are more likely to volunteer are generally supportive of our pre-registered prediction that women who are more integrated into the nation will be more likely to volunteer. However, after reviewing the literature on identity fusion in more detail it was not clear to us what predictions identity fusion theory would make in these circumstances. Fused individuals — people who feel kin like bonds with other members of the group, even those with whom they may have had little or no contact — are not expected to bond to the larger group simply because they share beliefs. In fact fusion relies on the development and maintenance of strong personal relationships with specific members within the larger group (Swann et al., 2010, 2012, 2014). Previous research has shown that education, intermarriage and remaining in western Finland throughout the war are some of the strongest predictors of social integration after the war (Lynch et al., 2019) Therefore, these results suggesting that the most socially integrated women were also the most likely to volunteer offers some support for the prediction that fused individuals are not just bound to the larger group by a sense of loyalty or duty to the collective. The fact that more socially integrated women were more likely to volunteer might indicate that successful fusion requires personal relationships and social networks that extend to specific members of the larger group (Swann et al., 2010, 2012, 2014). In other words, individuals who intermarried and remained in western Finland throughout the war might be expected to have more social relationships with non-Karelians and may therefore 'feel' more Finnish. On the other hand, identity fusion theory predicts that shared experiences involving psychological or physical suffering are also expected to increase the likelihood of fusion (Newson et al., 2016; Whitehouse, 2018). Here, we might make the opposite prediction and argue that the shared dysphoria of evacuees who returned to Karelia during the war and married fellow Karelians (i.e. identified more strongly with Karelia) will result in greater fusion. Overall, it remains unclear why women who were more socially integrated into the nation at large were more likely to volunteer. Indeed, the simplest explanation

may not involve identity fusion at all. The women who volunteered were more likely to be from higher social classes and these women are both more likely to intermarry and remain in western Finland throughout the war. Therefore, although some of these results are consistent with identity fusion theory, they could easily be understood within the framework of kin psychology or other theories of group alignment and identification. Indeed, there is nothing in particular in these results that establishes that relational and collective ties are directly responsible for women's decision to volunteer and future studies to confirm these results and provide evidence of causality. Future research should also seek to clarify some contradictions (e.g. regarding women with military aged sons) and include additional measures of group alignment.

Individual decisions to volunteer can have major impacts at the group level and kin psychology may have increased Lotta Svärd membership by the tens of thousands. Using kin psychology and insinuating threats to family members, either real or perceived, may be a particularly effective way to recruit individuals to make sacrifices for ideas or large groups of unrelated individuals such as nations, political parties or religions. This is frequently reflected in the propaganda of governments who have often intuitively understood that appealing to ethno-nationalism, tribal psychology and especially kinship (e.g. blood, family, brothers, sisters, forefathers, fatherland, motherland) is a good way to recruit new members. A review of speeches invoking ethno-nationalism have demonstrated that those which appeal to common ancestry and kinship have been most successful in eliciting mass popular responses (Connor, 1993).

Identity fusion predicts that the willingness to make sacrifices for an 'imagined' community (Anderson, 2006) of unrelated individuals is caused by the perception of a shared essence among group members. Fusion is expected to be triggered by an outgroup threat of sufficient magnitude and relies on the perception of shared traits or shared experiences by members of the threatened group (Whitehouse, 2018). Although making sacrifices for ingroups is likely a psychological response to a strong outgroup threat, our results suggest that women may be particularly motivated by threats to actual family members. This points to the importance of personal relationships and social networks in eliciting a willingness to sacrifice for the group. These findings are likely to be of broad interest to researchers in disciplines ranging from evolutionary biology and political science to social psychology and anthropology. Overall, our analysis is consistent with the hypothesis that group identity arose out of a psychological adaptation to facilitate cooperation among kin in the face of adversity (Whitehouse & Lanman, 2014). This study advances our understanding of the conditions under which individuals are more likely to sacrifice for their community and indicate that for women a willingness to sacrifice may rely on kin psychology whereby threats to actual family members trigger feelings of shared biology with other unrelated individuals in the threatened group.

Data availability

All data and code for these analyses and the construction of the figures from these models are available on a public repository on Github (Lottas, n.d.).

Author contributions

J.L. R.L. and V.L. conceived and designed the study. R.L. analyzed the data and wrote the paper. All authors edited and reviewed the

paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.evolhumbehav.2019.06.001.

References

Alice, H. (1986). Eagly and Maureen Crowley gender and helping behavior: A meta-analytic review of the social psychological literature. *Psychological Bulletin, 100*(3), 283.

Allman, J., Rosin, A., Kumar, R., & Hasenstaub, A. (1998, June). Parenting and survival in anthropoid primates: Caretakers live longer. In: *Proceedings of the National Academy of Sciences of the United States of America, 95*(12), 6866–6869.

Anderson, B. (2006). *Imagined communities: Reflections on the origin and spread of nationalism.* Verso Books.

Anon (1970). *Siirtokarjalaisten tie.* Turku, Finland: Nyky-Karjala.

Atran, S., & Gómez, Á. (2018). What motivates devoted actors to extreme sacrifice, identity fusion, or sacred values? *Behavioral and Brain Sciences, 41.*

Atran, S., Sheikh, H., & Gomez, A. (2014, December). Devoted actors sacrifice for close comrades and sacred cause. In: *Proceedings of the National Academy of Sciences of the United States of America, 111*(50), 17702–17703.

Bernhard, H., Fischbacher, U., & Fehr, E. (2006, August). Parochial altruism in humans. *Nature, 442,* 912.

Boyd, R., & Richerson, P. J. (1988). *Culture and the evolutionary process.* University of Chicago press.

Brewer, M. B., & Gardner, W. (1996). Who is this we? Levels of collective identity and self representations. *Journal of Personality and Social Psychology, 71*(1), 83.

Buhrmester, M. D., Fraser, W. T., Lanman, J. A., Whitehouse, H., & Swann, W. B., Jr. (2015). When terror hits home: Identity fused americans who saw boston bombing victims as "family" provided aid. *Self and Identity, 14*(3), 253–270.

Carsten, J. (1995, May). The substance of kinship and the heat of the hearth: feeding, personhood, and relatedness among malays in pulau langkawi. *American Ethnologist, 22*(2), 223–241.

Carsten, J. (2000). *Cultures of relatedness: New approaches to the study of kinship.* Cambridge University Press.

Chagnon, N. A. (1988, February). Life histories, blood revenge, and warfare in a tribal population. *Science, 239*(4843), 985–992.

Chapman, T., Arnqvist, G., Bangham, J., & Rowe, L. (2003, January). Sexual conflict. *Trends in Ecology & Evolution, 18*(1), 41–47.

Choi, J.-K., & Bowles, S. (2007, October). The coevolution of parochial altruism and war. *Science, 318*(5850), 636–640.

Clarke, M. (2008, March). New kinship, islam, and the liberal tradition: sexual morality and new reproductive technology in lebanon. *The Journal of the Royal Anthropological Institute, 14*(1), 153–169.

Connor, W. (1993, July). Beyond reason: The nature of the ethnonational bond. *Ethnic and Racial Studies, 16*(3), 373–389.

Fessler, D. M. T., & Navarrete, C. D. (2004). Third-party attitudes toward sibling incest: Evidence for Westermarck's hypotheses. *Evolution and Human Behavior, 25*(5), 277–294.

Gelman, A., Hill, J., & Yajima, M. (2012, April). Why we (usually) don't have to worry about multiple comparisons. *Journal of Research on Educational Effectiveness, 5*(2), 189–211.

Goldschmidt, W. (1988). In R. Rubinstein, & M. Foster (Eds.). *Inducement to military participation in tribal societies. The social dynamics of peace and conflict.* Westview: Boulder CO.

Gómez, Á., Morales, J. F., Hart, S., Vázquez, A., & Swann, W. B., Jr. (2011). Rejected and excluded forevermore, but even more devoted: Irrevocable ostracism intensifies loyalty to the group among identity-fused persons. *Personality and Social Psychology Bulletin, 37*(12), 1574–1586.

Goodrich, B., Gabry, J., Ali, I., & Brilleman, S.. *Rstanarm: Bayesian applied regression modeling via stan. (2018).* http://mc-stan.org/ (R package version 2.17.4.).

Hamilton, W. D. (1964). The genetical theory of kin selection. *Journal of Theoretical Biology, 7,* 1–52.

Henrich, J. (2015). *The secret of our success: How culture is driving human evolution, domesticating our species, and making us smarter.* Princeton University Press.

Jacques, K., & Taylor, P. J. (2008, April). Male and female suicide bombers: Different sexes, different reasons? *Stud. Conflict Terrorism, 31*(4), 304–326.

Katiha database. http://www.karjalatk.fi/katiha/index.php (Accessed: 2018–5-NA).

Kemppainen, I. (2005). Sota-ajan naisten monet roolit. *Jatkosodan pikkujättiläinen,* 454–474.

Lavery, J. E. (2006). *The history of Finland.* Greenwood Publishing Group.

Lieberman, D., Tooby, J., & Cosmides, L. (2007, February). The architecture of human kin detection. *Nature, 445*(7129), 727–731.

Loehr, J., Lynch, R., Mappes, J., Salmi, T., Pettay, J., & Lummaa, V. (2017, October). *Newly digitized MiKARELIA database reveals the journeys of second world war forced migrants from finnish Karelia.* Finnish Yearbook of population Research.

Lottas, L.. https://github.com/robertlynch66/Lottas (2018. Accessed: 2018-NA-NA).

Lynch, R., Lummaa, V., Rotkirch, A., Danielsbacka, M., O'Brien, D., & Loehr, J. (2019). *Integration involves a trade-off between fertility and status for finnish evacuees in world war II.*

Lynch, R., Lummaa, V., Panchanathan, K., Middleton, K., Rotkirch, A., Danielsbacka, M., … Loehr, J. (2019). Integration involves a trade-off between fertility and status for world war ii evacuees. *Nature Human Behaviour, page, 1.*

Macfarlan, S. J., Walker, R. S., Flinn, M. V., & Chagnon, N. A. (2014, November). Lethal coalitionary aggression and long-term alliance formation among yanomamö men. In: *Proceedings of the National Academy of Sciences of the United States of America, 111*(47), 16662–16669.

McElreath, R. (2015). *Statistical rethinking. texts in statistical science.*

McElreath, R. (2016). *Rethinking: Statistical rethinking book package.* (R Package Version 1.59).

McNamara, R. A., & Henrich, J. (2017, March). Kin and kinship psychology both influence cooperative coordination in Yasawa, Fiji. *Evolution and Human Behavior, 38*(2), 197–207.

Melissa, M., McDonald, C. D. N., & Van Vugt, M. (2012, March). Evolution and the psychology of intergroup conflict: the male warrior hypothesis. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences, 367*(1589), 670–679.

Navarrete, C. D., McDonald, M. M., Molina, L. E., & Sidanius, J. (2010, June). Prejudice at the nexus of race and gender: an outgroup male target hypothesis. *Journal of Personality and Social Psychology, 98*(6), 933–945.

Nevala-Nurmi, S.-L. (2006). Girls and boys in the finnish voluntary defence movement. *Ennen & nyt,* 3–4.

Newson, M., Bortolini, T., Buhrmester, M., da Silva, S. R., da Aquino, J. N. Q., & Whitehouse, H. (2018). Brazil's football warriors: Social bonding and inter-group violence. *Evolution and Human Behavior, 39*(6), 675–683.

Newson, M., Buhrmester, M., & Whitehouse, H. (2016, August). Explaining lifelong loyalty: The role of identity fusion and Self-Shaping group events. *PLoS ONE, 11*(8), e0160427.

Ollila, A. (1995, January). Women's voluntary associations in finland during the 1920s and 1930s1. *Scandinavian Journal of History, 20*(2), 97–107.

Olsson, P. (2005). *Myytti ja kokemus: Lotta Svärd sodassa.* Kustannusosakeyhtiö Otava.

Park, J. H., & Schaller, M. (2005, March). Does attitude similarity serve as a heuristic cue for kinship? Evidence of an implicit cognitive association. *Evolution and Human Behavior, 26*(2), 158–170.

Pohls, M., & Latva-Äijö, A. (2009). *Lotta Svärd: käytännön isänmaallisuutta.* Otava.

Prentice, D. A., Miller, D. T., & Lightdale, J. R. (1994). Asymmetries in attachments to groups and to their members: Distinguishing between common-identity and common-bond groups. *Personality and Social Psychology Bulletin, 20*(5), 484–493.

Richerson, P., & Henrich, J. (2009, March). *Tribal social instincts and the cultural evolution of institutions to solve collective action problems.*

Robert, L. (1971). Trivers. The evolution of reciprocal altruism. *The Quarterly Review of Biology, 46*(1), 35–57.

Swann, W. B., Buhrmester, M. D., Gómez, A., Jetten, J., Bastian, B., Vázquez, A., … Zhang, A. (June 2014). What makes a group worth dying for? Identity fusion fosters perception of familial ties, promoting self-sacrifice. *Journal of Personality and Social Psychology, 106*(6), 912–926.

Swann, W. B., Jetten, J., Gómez, A., Whitehouse, H., & Bastian, B. (July 2012). When group membership gets personal: A theory of identity fusion. *Psychological Review, 119*(3), 441–456.

Swann, W. B., Jr, A. G., Huici, C., Morales, J. F., & Hixon, J. G. (2010, November). Identity fusion and self-sacrifice: Arousal as a catalyst of pro-group fighting, dying, and helping behavior. *Journal of Personality and Social Psychology, 99*(5), 824–841.

Swann, W. B., Jr, A. G., Seyle, D. C., Morales, J. F., & Huici, C. (2009, May). Identity fusion: The interplay of personal and social identities in extreme group behavior. *Journal of Personality and Social Psychology, 96*(5), 995–1011.

Tajfel, H., Turner, J. C., Austin, W. G., & Worchel, S. (1979). *An integrative theory of intergroup conflict. organizational identity: A reader.* 56–65.

Taylor, S. E., Klein, L. C., Lewis, B. P., Gruenewald, T. L., Gurung, R. A., & Updegraff, J. A. (2000, July). Biobehavioral responses to stress in females: tend-and-befriend, not fight-or-flight. *Psychological Review, 107*(3), 411–429.

Trivers, R. (1972). Parental investment and sexual selection. *Sexual selection and the descent of man. Vol. 136.* Cambridge, MA: Biological Laboratories, Harvard University.

Tuunainen, P. (2016). Professional leaders and citizen soldiers as an effective fighting force. *Finnish military effectiveness in the winter war. 1939–1940. Finnish military effectiveness in the winter war* (pp. 135–170). Springer.

Van Vugt, M. (2009, June). Sex differences in intergroup competition, aggression, and warfare: The male warrior hypothesis. *Annals of the New York Academy of Sciences, 1167,* 124–134.

Vázquez, A., Gómez, Á., & Swann, W. B. (2017). Do historic threats to the group diminish identity fusion and its correlates? *Self and Identity, 16*(4), 480–503.

Wang, X. T., Kruger, D. J., & Wilke, A. (2009, March). Life history variables and risk-taking propensity. *Evolution and Human Behavior, 30*(2), 77–84.

Whitehouse, H. (2018, February). Dying for the group: Towards a general theory of extreme self-sacrifice. *The Behavioral and Brain Sciences,* 1–64.

Whitehouse, H., & Lanman, J. A. (2014). The ties that bind us: Ritual, fusion, and identification. *Current Anthropology, 55*(6), 674–695.

Williams, G. C. (1966). *Adaptationand natural selection (prin).*