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Disgust, Gender, and Social Change
Testing Alternative Explanations for the Decline of Cousin Marriage in Karo Society

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Abstract Among the Karo of Indonesia, the frequency of matrilateral cross-cousin (*impal*) marriage has declined in recent decades. We conducted a vignette experiment to assess the contributions of a handful of factors in shaping this pattern. Surprisingly, we found that cosocialization of a hypothetical woman with her impal led to increased judgments of marriage likelihood and decreased feelings of disgust in male and female respondents ($n = 154$). We also found that females, more than males, judged impal marriage more likely when there were practical advantages. Finally, we found that younger men expressed more disgust in response to impal marriages than did older men, while women displayed an opposite but weaker reaction. This suggests the existence of gender-specific changes in attitudes toward the practice, indicating that a full understanding may require the application of sexual conflict theory. Our study illustrates the potential utility—and limitations—of vignette experiments for studying social change.

Keywords Karo Batak · Social change · Cousin marriage · Westermarck hypothesis · Disgust · Sexual conflict

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We are so prone to attribute a phenomenon to a single cause, that, when we find an agency present, we are liable to rest satisfied therewith, and fail to recognize that it is but one factor, and perchance a minor factor, in the accomplishment of the final result.

T. C. Chamberlin (1890)

Introduction

The study of continuity and change in cousin-marriage norms sheds light on general questions relating to preferential marriage, as well as broader issues of the dynamic relationship between ideal social norms and actual behavior (Good 1981; Needham and Elkin 1973), and the interplay of biology and culture (Bittles 2012; Guillot et al. 2015). Although some early studies (e.g., McVicar 1935) acknowledged the contribution of multiple determinants in shaping the form and frequency of cousin marriage, the most notable debates have centered on the primacy of individual determinants (e.g., Homans and Schneider 1955; Needham 1962). It is now clear that explaining cousin marriage requires the investigation of multiple factors, sometimes antagonistic, with systematic methods. With the exception of some parts of the Middle East (Hamamy et al. 2005), rates of cousin marriage are decreasing globally (Bittles 2012). Although it is tempting to explain this trend as a mere by-product of "modernization" (i.e., the loss of traditional beliefs and practices because of industrialization, colonialism, and other factors [Carmack 2013]), such broad-brushstroke accounts are frequently inadequate since social change can be driven by different factors at different times and places. Here, by examining a specific case of preferential cousin marriage, we seek to demonstrate how quantitative ethnographic data provide a unique window through which we can view a society as it changes.

We examine cross-cousin marriage among the Karo people of North Sumatra, Indonesia. The results presented here are part of a larger quantitative ethnographic and archival study of matrilateral cross-cousin marriage in Karo society. Our work to date suggests that the frequency of this type of marriage has declined steadily from the 1930s to the present. We thus have the dual aims of trying to explain both why the rate is currently so low and why it has declined so dramatically in recent times. We use a factorial vignette experiment that allows us to assess respondents' own perceptions of the factors that may have played a role in driving down cross-cousin marriage. The design also allows us to test the idea that growing up in close proximity to their own cross-cousins would affect respondents' judgments of disgust in the manner predicted by recent work related to Westermarck's (1891) theory of negative imprinting.

Decline of Impal Marriage

The Karo are one of six "Batak" groups from North Sumatra, Indonesia (Kipp 1993; Kushnick 2006; Singarimbun 1975; Steedly 1993). Among the Karo, marriages are clan exogamous, with a stated ideal for marriage between a specific type of opposite-sex cousin referred to as *impal*. Although a number of cousins are considered impal, the

two types of "proper" impal marriages are between matrilateral cross-cousins of the first-cousin (MBD-FZS) and second-cousin (MFBSD-FFBDS) variety. In theory, this system of marriage—which has been called the "circulating connubium" (van Wouden 1935) or assymetrical alliance—functions to bolster interlineage alliances and maintain ritual status differentials (Leach 1951; Levi-Strauss 1949; Needham 1986). A given patrilineage acts as wife-givers (*kalimbubu* among the Karo) for a second patrilineage, and wife-takers (*anakberu* among the Karo) for a third. Ideally, under this arrangement the wife-giver/wife-taker relationship is perpetual, and one's wife and mother are born from the same patrilineage. In practice, however, impal marriages are rare. In his classic ethnography of the Karo, Singarimbun (1975) reports that only 4% of the marriages he documented in the 1960s were between proper impal.

Our ongoing investigation of marriage and baptism records from the Catholic parish office in Kabanjahe suggests that the rate has not always been so low. Figure 1a shows that the rate of consanguineous marriages (full height of bars) decreased more-or-less steadily from 1948 to 2000. It also shows that the rate of impal marriages decreased from 11 to 4% (the rate of potential impal marriage is measured as the sum of the percentage of marriages that we know definitively were impal based on notes in the marriage records and the percentage that are likely impal but require confirmation via our ongoing reconstructions of individual genealogies). A more definitive answer will also need to show that the change extends beyond the sample of Karo people represented in the church records because the majority of Karo people are Protestant, not Catholic. We conducted complete censuses of all Karo marriages in three villages. Figure 1b shows that the general pattern of decline evident in our ethnographic data corroborates the decline that we found in our archival work.

Independent of the changes that our work to date reveals, we can ask whether the rates of impal marriage that we have documented are lower than would be expected based on comparisons with systems of preferential cousin marriage in other societies. Although the specific demographic, political, and social structural considerations at
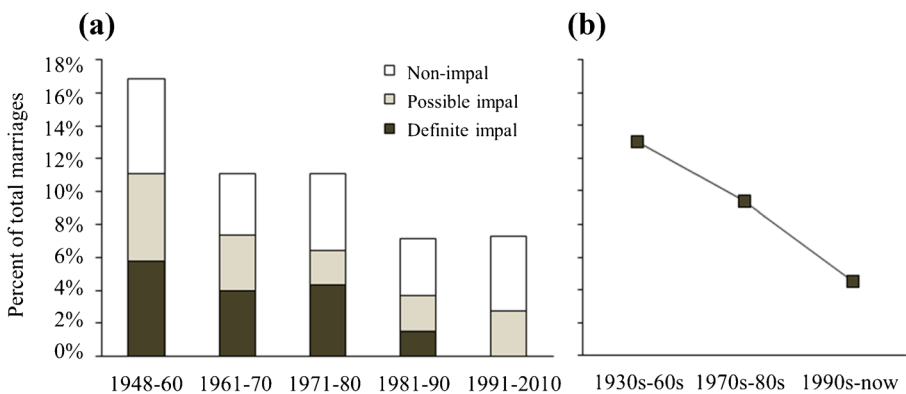

Fig. 1 Evidence for the decreasing rate of impal marriage among the Karo from (**a**) archival records (*n* = 2297 marriages) and (**b**) a census of all marriages in three villages (*n* = 372 marriages). In (**a**), the full height of the bars show the rate of consanguineous marriage by years; the *dark bars* show the percentage that is definitively and the *lightly shaded* possible, impal marriages; the *white bars* show the percentage that is definitely not impal marriages

play vary substantially from society to society, when we examine demographic studies of cousin marriage conducted in other cultures from the 1950s to the present, we find rates from 9 to 35%, with a majority in the 15–25% range (Assaf and Khawaja 2009; Ayoub 1959; Barth 1954; Bener and Alali 2006; Hamamy et al. 2005; Jurdi and Saxena 2003; Koc 2008; Othman and Saadat 2009; Radovanovic et al. 1999). In the case of impal marriage, the maximum rate possible may be lower than the peak rate observed in these studies because if one of a set of siblings is married to their impal then the others in that set must not be. Assuming each sib set has four members, as we did in our previous work (Kushnick and Fessler 2011), the maximum rate possible may thus be on the order of 25%. However, even this ceiling is far above the rates observed and, moreover, may be too conservative: Kunstadter et al. (1963) conducted simulations of cousin marriage employing a more dynamic approach to demographic rates, finding that matrilateral cross-cousin marriage occurred between 15 and 40% of the time in three-quarters of the simulations. In sum, viewed against both the larger ethnographic corpus and models of possibilities, the rate of impal marriage is indeed low.

Possible Explanations for the Decline in Impal Marriage

There are a number of potential explanations for the rarity and decline of impal marriage. Here, we assess the relative importance of four non-mutually-exclusive factors.

Demography

The first potential explanation concerns the availability of appropriate marriage part-ners. One cannot marry an impal if none are available or none are of the appropriate age, and demographic changes can alter this. In a society that has transitioned to a lower fertility rate, the frequency of marriage to a specific class of cousin may decrease owing to the reduced availability of appropriate potential partners. This type of demographic constraint has played a role in existing accounts of lower-than-expected rates of cousin marriage (Kunstadter et al. 1963; Leach 1962). Driven in large part by a concerted national family-planning effort, Indonesia was thrust into a demographic transition in the early to mid-1970s, with a total fertility rate of 5.61 in 1971 plummeting to 2.30 by 2002 (Hirschman 1994; Jones 1997). Fertility rates among the Karo are higher than the national average, with total fertility rates in the 3.3 to 4.4 range (Kushnick 2006, 2010). Our previously published model of impal marriage (Kushnick and Fessler 2011) suggests a total fertility rate of 3 to 4 would yield, for a single person, 6 to 8 marriageable impal. Some are likely to be inappropriate on account of age. Nevertheless, even taking this and the proscription of siblings marrying impal, we believe demographic factors alone can, at best, account for only a small portion of the low rate and decline of impal marriage.

Religion

The second potential explanation concerns the influence of religion on marriage, where religion refers to a source of authority and adjudication of social practices. In the past, Karo Batak people held animistic religious beliefs; today most are members of various

Protestant or Catholic churches (Kipp 1990, 1993; Pederson 1970; Rae 1994). Protestant churches generally do not prohibit cousin marriage. The Catholic Church is permissive, requiring dispensation for marriages between close relatives. Although some missionaries to Indonesia viewed these practices as backward or pagan (Aritonang and Steenbrink 2008), according to Joosten Ginting (2006), the Catholic Church, which has been present in Tanah Karo since the 1940s, has been quite lenient in giving dispensations for these marriages among the Karo, requiring only that the bride's and groom's parents agree. Elsewhere in Indonesia, the local parish leadership has been less lenient. Hicks (1988:400) describes "condemnation by the church" and subsequent cessation of preferential first cousin marriage among the Manggarai of Flores. There are few data on the prevalence of impal marriage before the adoption of Christianity, but since that time, the rate has steadily dropped. For these reasons, we continue to evaluate the impact of religion.

Alliance

The third potential explanation centers on the functions of marriage to create and maintain alliances between descent groups (Leach 1951; Levi-Strauss 1949; Needham 1986). Systems with preferred or prescribed matrilateral cross-cousin marriage, such as among the Karo, are referred to as asymmetric alliance systems (Needham 1961). Although these systems are found in diverse societies around the world, they are disproportionally represented in Indonesia (Beatty 1990; Forth 1990; Hicks 1988; Howell 1995; Kipp 1983). Within this system, actors may strategically form alliances and manipulate the system of descent so as to keep farmland, the most valued resource among the Karo Batak, "in the family" (Kushnick 2010). Alliance is only a viable explanation for the decline of impal marriage if the nature or impact of alliance-building has changed. One aspect of alliance that has clearly changed among the Karo Batak, and elsewhere in Indonesia, is that marriage alliances are now built between a small subset of generations of the same family rather than between entire patrilineages (Kipp 1983; Needham 1978). Nonetheless, marriage-based alliances are still maintained, and parents still retain some influence over marriage decisions (e.g., through the veto power of the brideprice). It is possible that penetration of the national state and increased participation in a market economy have led to a decrease in the value of maintaining these sorts of alliances, but it is also possible that the opposite is true.

Negative Imprinting

The fourth potential explanation is that, despite prescriptive norms, impal themselves do not wish to marry one another as a consequence of experiencing the sexual aversion that Westermarck (1891) hypothesized develops when individuals are raised in propinquity. Multiple lines of evidence suggest that such "negative imprinting" is the output of an adaptive mechanism whereby individuals identify cosocialized others as kin as part of a process to minimize inbreeding (e.g., Rantala and Marcinkowska 2011). This effect can hold independent of the actual degree of inbreeding, as the postulated adaptation is thought to operate simply on the basis of cues that, on average, indexed close biological relatedness in ancestral human populations.

The most convincing evidence for the Westermarck effect comes from natural experiments wherein individuals are raised in a context that causes the adaptive mechanism to misfire in a predictable way. This is the case in Taiwanese "minor" marriages, where the bride (known as *sim pua*) is adopted into her future husband's family as an infant or small child (Lieberman 2009; Wolf 1966, 1995; see also Mattison et al. 2015). Although unrelated, the bride and groom show signs of sexual aversion at maturity, with lower fertility and higher probability of divorce than among those in major marriages. Negative imprinting has also been documented among unrelated children co-reared on Israeli kibbutzim (Lieberman and Lobel 2012). Further evidence comes from experimental studies that show negative reactions to hypothetical incest when the subject exposed to the scenario (Fessler and Navarrete 2004; Lieberman et al. 2003, 2007) or the actors in the scenario themselves (Antfolk et al. 2012a) have been cosocialized with opposite-sex siblings.

Fessler (2007) hypothesized that the low rate of impal marriage might be due to Westermarckian negative imprinting. However, Kushnick and Fessler (2011) later showed via a simple mathematical model that cosocialization of matrilateral cross-cousins would never have occurred frequently enough for a Westermarck effect alone to account for the low rate.

One might assume that the type of cosocialization that leads to Westermarckian sexual imprinting would require impal to live in the same household from a young age and for a prolonged period. Ethnographic data collected from a sample of 44 male and 70 female Karo respondents between the ages of 20 and 75 ($M = 42.5$, SD = 12.3) who had never been married to their 1 to 14 ($M = 4.6$, SD = 2.4) opposite-sex impal revealed that, although only 5.3% of them had ever lived in the same house as their impal from birth to age 10, 32.5% had lived in the same village as their impal from birth to age 10 (regarding the ages used to define the cosocialization window, we sought a compromise between the more restrictive [e.g., 6 years] and less restrictive [e.g., 18 years] windows variously employed in prior work on this topic [discussed in Lieberman 2009; Rantala and Marcinowska 2011]). Can living in the same Karo village but not the same house lead to negative imprinting? For the following reasons, we believe the answer is possibly yes. First, the residence itself is not what is important, but the sustained observation of shared parental care, and perhaps shared meals and bathing (Lieberman and Billingsley 2015). In a Karo village, cousins are very likely to experience this sort of co-rearing, a pattern that is compounded by the fact that the obligations of kalimbubu to their anakberu in Karo society lead to intimately intertwined daily interactions, including shared parental care (Kushnick 2012). As confirmation of these observations, when the respondents discussed above were asked whether they "interacted often or all the time [with their impal] when growing up," the percentages of participants answering in the affirmative were similar when the target impal resided in the same village but not the same house as the respondent (39.8%) and when the target impal lived in the same house as the respondent (33.3%); in contrast, these frequencies were both drastically different when the target impal had never lived in the same village or house as the participant (16.4%).

Although the above measures are both of lower resolution and less distinctly quantified than are the indices of co-rearing experiences and witnessed maternal perinatal investment (including breastfeeding) employed in the best prior studies of Westermarckian natural experiments (e.g., Lieberman 2009; Lieberman and Lobel 2012; Wolf 1995; see also Wolf and Huang 1980), nevertheless, they provide a preliminary, if indirect, basis for examining the possibility that negative imprinting contributes to the low rate of impal marriage among the Karo.

Approaches to Studying Multiple Causation

The shortcomings of focusing on a single hypothesis have long been recognized. Chamberlin (1890) advocated what he called the "method of multiple working hypotheses," which is summarized by Railsback (2004) as "open-mindedly envision[ing] all the possible explanations to be studied, including the possibility that none are correct [because] careful study often shows that a phenomenon is the result of several causes, not just one, and the method of multiple working hypotheses obviously makes it more likely that we will see the interaction of the several causes." Today, three principal methods for assessing multiple hypotheses are used (Dochtermann and Jenkins 2011; Hilborn and Stearns 1982): (a) Model selection methods fit data to multiple competing statistical models. Systematic methods are then used to assess the fit of the models, such as Akaike's information criteria (AIC) or likelihood ratio tests. (b) Prediction-based methods sequentially test a priori hypotheses. Ideally, one of the alternatives emerges as a clear winner, but oftentimes this is not the case. (c) Other methods, such as factorial experiments, allow researchers to simultaneously assess the contribution of a number of factors and their interactions. In the current study we use a combination of model selection methods based on maximum likelihood estimation and AIC, and also on factorial experiments.

Factorial experiments allow for quantification of the effects of multiple causative factors and their interactions without confounding (Fisher 1935). Vignette experiments provide a means for systematically studying the effects of experimentally manipulated factors on people's judgments, perceptions, and feelings (Alexander and Becker 1978; Atzmüller and Steiner 2010). Although vignette studies have been recognized as a potentially powerful addition to the anthropologist's toolkit (Bernard 2011), to date, ours is its first application to study a problem of social change in a small-scale population. Factorial vignette experiments combine the power of both approaches. The approach is not without limitations (Atzmüller and Steiner 2010; Hughes and Huby 2004; Kushnick 2013).

First, although experimental psychologists extoll the virtues of between-subjects designs to minimize demand characteristics, such an approach is rarely feasible in factorial experiments in small-scale societies. For anything but the simplest designs (e.g., 2×2), large sample sizes are necessary to achieve sufficient statistical power. Between-subjects designs require larger samples than within-subjects designs. Further, the within-subjects approach avoids the potential bias of using between-subjects designs when the outcome is a judgment (Birnbaum 1999). Thus, the use of a within-subjects design is a necessary by-product of the factorial approach, so the analysis of these kinds of experiments requires statistical techniques that adjust for multiple responses from a single subject.

Second, within-subjects designs of the type employed here suffer the limitation that presenting multiple variants of a single scenario can lead participants to question why seemingly similar questions are being asked repeatedly. However, although demand characteristics cannot be eliminated entirely, provided that the participant is blind to the hypothesis at issue, it will often be opaque to participants as to whether, by seemingly repeating the questions, the investigator is seeking to lead participants to alter their responses or is probing to see whether participants remain steadfast in their responses. Granted, normative standards dictated by, for example, prevailing religious doctrine can influence participants' guesses as to the investigator's intentions in using multiple probes, but such factors can often be identified via participants' steadfast adherence to single responses. Relatedly, although impression management and demand characteristic concerns can be reduced through the use of printed materials, anonymous administration, and similar distancing procedures, such techniques are not practical when, as is often the case in small-scale societies, a substantial fraction of participants is either illiterate, inexperienced with the research process, or both (Hughes and Huby 2004). Notwithstanding the above limitations, in an exploratory venture such as ours, on balance the advantages of a factorial vignette experiment in a field setting outweigh such liabilities.

Methods

Experimental Design

We conducted a vignette experiment with the aim of quantifying perceptions of impal marriage and its decline among Karo people. We did so by visiting 58 villages in the Karo and Deli Serdang regencies of North Sumatra, Indonesia, between March and July, 2014 (Fig. 2). Participants were presented with vignettes describing a hypothetical Karo woman and then were asked two questions. The goal of the first question was to quantify the effects of four binary factors pertaining to the protagonist in the vignette (religion, descent/alliance, demography, and cosocialization—precise wording of the levels for each factor is shown in Fig. 3) on the likelihood the hypothetical woman would marry her impal. The goal of the second question was to quantify reported feelings of disgust as a function of factors pertaining to the respondent (age and cosocialization history with his or her own impal) and third-party cosocialization as described in the vignette. The full set of 16 vignettes was constructed factorially—in other words, using all possible combinations of four binary factors ($2^4 = 16$). As shown in Fig. 3, the binary factors were designed as follows: "demography" varies the number of marriageable impal available to the woman; "descent/alliance" varies the amount of practical advantage to the family of the hypothetical woman for marrying her impal; "religion" varies the attitudes of others at the woman's church; and "cosocialization" varies the degree of propinquity between the woman and her male impal during infancy and childhood. The vignettes were divided into four sets using the Design of Experiments function in JMP® 2.0 so that all main and first-order interaction effects could be estimated without confounding. To minimize respondent fatigue, each participant was presented with a subset of the 16 vignettes, by assigning them to one of the
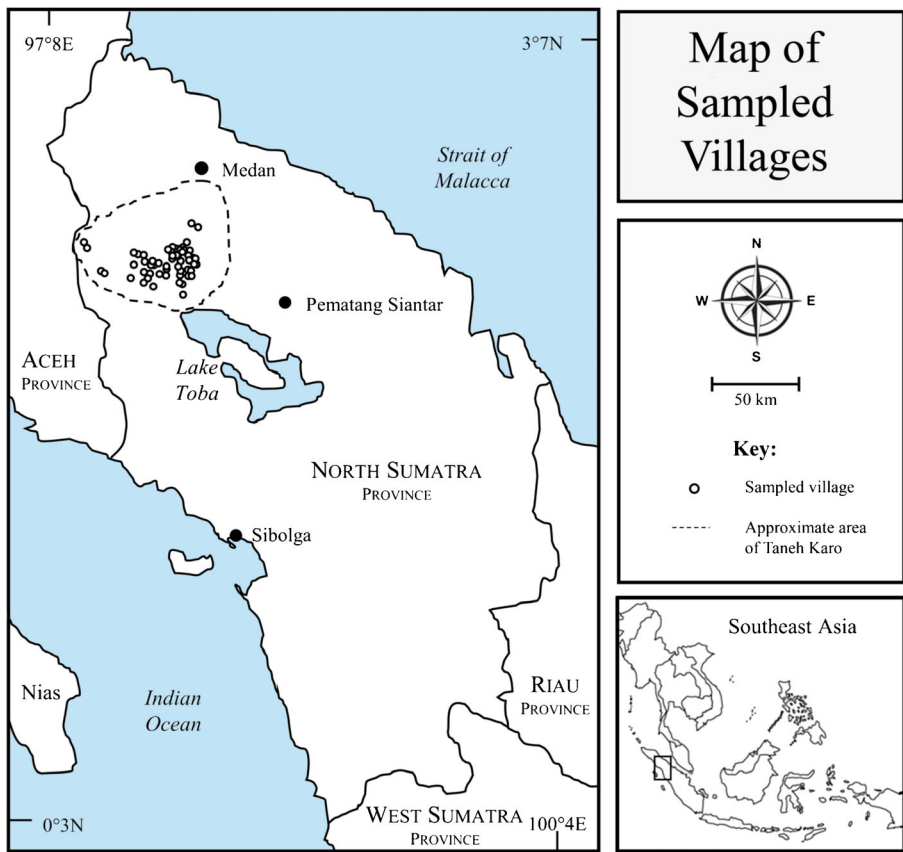
Fig. 2 Map of North Sumatra showing the approximate area of Taneh Karo (*hashed line*) and the 58 villages from which we recruited respondents for the vignette experiment (*white dots*)

four sets and presenting the vignettes in one of two counterbalanced orders, as shown in Table S1 (see ESM).

Procedures and Participants

We approached adults at random during our visits to the sampled villages, asking each their age, ethnicity, and whether they were raised in close association with their impal. This allowed us to draw a random sample of Karo people stratified by gender, age, and cosocialization experience as outlined in Table S2 (see ESM). Each participant was then interviewed in Bahasa Indonesia (the national language of Indonesia) in a semi-private location, enabling individuals to participate without interference and without fear that their responses would be seen or overheard. Two of our field assistants were fluent in Bahasa Karo (the regional language) and were called upon to translate for participants who had limited understanding of Bahasa Indonesia.

First, participants were asked a series of questions about their age and history of cosocialization with their opposite-sex impal—whether or not, for each year from birth
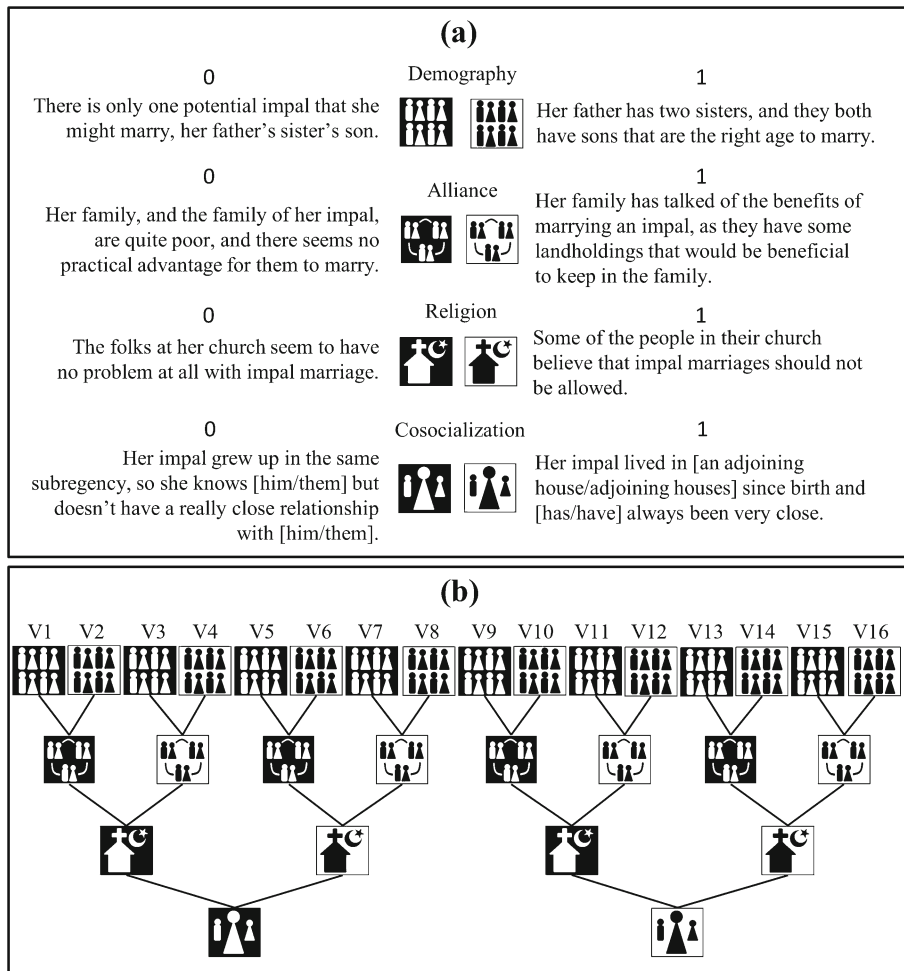
Fig. 3 Wording of the vignettes and a schematic illustration of the full set of vignettes: (**a**) the four binary factors included in the vignettes and the complete wording for both levels of each factor and (**b**) a schematic illustration of the full set of 16 vignettes ($2^4 = 16$), with each vignette (V1-V16) showing which level was included for each factor

to age 10, they lived in the same village. This procedure was then repeated addressing coresidence in the same house. Second, respondents were presented with the vignettes and questions. All vignettes were prefaced with the following statement: "A woman in a Karo Batak village like this one has come of age to marry." As one tool for assessing whether perceptions of impal marriage have changed, half of the respondents were also told to "imagine it is the year that you turned 18." After the presentation of each vignette, participants were asked two questions in fixed order: (1) "How likely would the woman in the story be to marry her true impal?" Participants were asked to respond by pointing to a scale with the following responses on it: very likely, likely, neutral, unlikely, and very unlikely. (2) "How much disgust would you feel if the woman in the story married her true impal?" Participants were asked to respond by pointing to a scale

with the following responses on it: not disgusting, disgusting, and very disgusting.[1] The anchor points were read aloud to illiterate participants and were translated in cases where Bahasa Karo was employed.

Interviewers entered the responses directly into an Android-powered digital data-collection form equipped with the ODK (Open Data Kit) Collect application. The XLS Form code used to create our data-collection form and the study's raw data are available online via figshare (Kushnick et al. 2016).

Analyses

The responses to the two questions were analyzed with a series of regression models estimated with robust standard errors to adjust for repeated measures. Each model had two versions: one estimated with responses from female respondents, the other with responses from male respondents. The models used for inference were selected using averaged Akaike's information criterion values (AIC_M) calculated by taking the mean of the AIC values of the male and female models. All analyses were conducted in Stata® 13.

For Question 1, the dependent variable was the respondent's judgment of the likelihood that the hypothetical woman in the vignette would marry her impal, with values ranging from +2 for very likely to −2 for very unlikely. The distribution of responses, as illustrated in Figure S1 (see ESM) allowed us to use linear regression models. All models included the main effects of the binary factors in the vignettes. Those with the Design descriptor included dummy variables for set and order effects. Those with the Respondent descriptor included terms for the age of the respondent in years, whether the vignette was framed as occurring now (Time = 0) or in the past (Time = 1), and the extent of the respondent's cosocialization with his or her impal. For the cosocialization term, we used two different codings, both imprecise: (*a*) the number of years in the same house as his or her impal from birth to age 10, a coding that probably underestimates the number of couples that have negatively imprinted on each other, and (*b*) the number of years in the same village as his or her impal from birth to age 10, a coding that may overestimate the number of negatively imprinted couples. Those with the Interaction descriptor also included terms for all possible first-order interaction effects between the four main factors.

For Question 2, the dependent variable was the respondent's judgment of how disgusting it would be if the hypothetical woman in the vignette married her impal, with values ranging from +2 for very disgusting to 0 for not disgusting. The distribution of responses, as illustrated in Figure S2 (see ESM), allowed us to use Poisson regression models. All models included the main effects: respondent cosocialization with impal in years (coded as both number of years from birth to age 10 in the same house and in the same village, as discussed above), the binary factor for cosocialization of the hypothetical woman and her impal in the vignette, age of respondent in years, and whether the vignette was framed as occurring now (Time = 0) or in the past (Time = 1). Those with the Design descriptor included set and order effects. Those with the Other descriptor included the remaining three factors from the vignettes.

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[1] We used the Indonesian word *jijik*. This translated directly as 'disgust' with both the visceral (e.g., elicited by cues of pathogen presence) and social (e.g., moral disapproval) connotations that this term has in English. In the few cases where the participant did not speak Indonesian, a research assistant fluent in Bahasa Karo explained it to them.

Perspective

We used the concept of *perspective* as applied to vignette studies (Hughes and Huby 2004) in two strategic ways: First, we crafted the vignettes to feature a hypothetical woman, regardless of the participant's gender. Since brides are most often younger than their grooms, this perspective allowed us to simplify the wording of the vignettes. For negative imprinting to occur, the younger of the pair only needs to live in close association with the other (Lieberman and Billingsley 2015). Second, we varied the presentation of the vignette as occurring in the present or in the past to assess the presence of secular change in perceptions of impal marriage. Our model selection procedures ensured that Time and Age were considered together because imagining back to age 18 is different for a 20-year-old (who is being asked about a time 2 years prior to the present) and a 67-year-old (who is being asked about a time 49 years prior to the present). We acknowledge the limitations of eliciting judgments based on retrospective hypotheticals, but we hope to tap people's memories of things they are likely to remember, such as marriages in their community and any feelings of disgust in response to them (Croucher et al. 2011).

Results

After excluding two respondents from the analyses because of incomplete information, we had a corpus of 860 judgments provided by a sample of 215 respondents (Table 1). The sampling strategy was successful in that there were almost equal numbers of men and women, and there was no significant gender difference in age or years cosocialized with impal.

Table 1 Descriptive statistics

	Male		Female		Total	
	M	SD	*M*	SD	*M*	SD
Respondents	*n* = 106		*n* = 109		*n* = 215	
Age (yrs)	43.2	17.5	42.2	17.9	42.7	17.7
Same village (yrs) [a]	4.6	4.9	4.5	4.9	4.6	4.9
Same house (yrs) [a]	0.5	2.1	0.4	2.0	0.5	2.1
Q1 Judgments	*n* = 424		*n* = 436		*n* = 860	
How likely? [b]	0.6	0.9	0.4	0.9	0.5	0.9
Q2 Judgments	*n* = 424		*n* = 436		*n* = 860	
How disgusting? [c]	0.3	0.5	0.2	0.5	0.3	0.5

[a] Number of years from birth to age 10 in same village or house as opposite-sex impal

[b] +2 very likely, +1 likely, 0 neutral, −1 unlikely, −2 very unlikely

[c] 0 not disgusting, +1 disgusting, +2 very disgusting

Table 2 Coefficients from the most well supported linear regression models used to estimate the effects of various factors on judgments of the likelihood of impal marriage

Main Effect	Female respondents [a]			Male respondents [a]		
	Main	Main + Design [b]	Main + Respondent (house)	Main	Main + Design [b]	Main + Respondent (house)
Religion	−0.112	−0.113	−0.112	−0.086	−0.086	−0.086
Alliance	0.196*	0.174	0.201*	0.107	0.109	0.098
CS (3rd party)	0.439***	0.439***	0.439***	0.374***	0.374***	0.374***
Demography	0.110	0.111	0.110	0.012	0.012	0.012
Time	–	–	0.062	–	–	0.056
Age	–	–	0.002	–	–	0.002
CS (same house)	–	–	−0.060	–	–	0.013

All models with female respondents are $n = 436$ (109 respondents); all models with male respondents are $n = 424$ (106 respondents)

[a] Significance: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

[b] Main + Design models control for design characteristics (i.e., set effects and order)

Likelihood of Marriage

Using AIC_M as the criteria, three of the twelve candidate models in Table S3 (see ESM) were reasonably well supported: Main + Design, Main, and Main + Respondent (house). All others were less to substantially less well supported. The model summaries presented in Table 2 show that, for both the male and female versions of these models, there was little difference in estimated effects. In all models, the dependent variable was a judgment of the likelihood that the woman in the vignette would marry her impal on a five-point scale ranging from +2, very likely, to −2, very unlikely. Full details of both models are included in Table S4 (see ESM).

As shown in Table 2, the estimated effects in the models estimated with judgments from female respondents were almost identical. Cosocialization of the hypothetical woman had a large and statistically significant effect in both models. When the woman in the scenario was cosocialized with her impal, female respondents judged her as 44% of a step *more* likely to marry him (a "step" being the distance between "very likely" and "likely," for example, or between +2 and +1). When the marriage was described as having a practical advantage for the families involved, female respondents judged the hypothetical woman as 17 to 20% of a step more likely to marry her impal, and the effect was statistically significant in two of three models. All other variables of interest had much smaller effects and were not statistically significant. The effect of religious disapproval led to a reduction of 11% of a step in judgments that the couple would be likely to marry. The availability of an additional marriageable impal led to an increase of 11% of a step. The Main + Respondent (house) model included cosocialization of the respondent with their own impal, and the two factors—time and age of respondent— that we used to probe potential changes in perceptions of impal marriage through time, but the effects were negligible and not significant.

As shown in Table 2, the estimated effects in the models estimated with judgments from male respondents were also almost identical. Cosocialization (abbreviated "CS" in the tables) of the hypothetical woman had a large and statistically significant effect in both models. When the woman was cosocialized with her impal, male respondents judged her as 37% of a step *more* likely to marry him. All other variables of interest had much smaller effects and were not statistically significant. The effect of religious disapproval led to a reduction of 9% of a step in judgments that the couple would be likely to marry. Up to this point, the results from male respondents are quite similar to those from female respondents. The following, however, are quite different. First, the availability of an additional marriageable impal led to an increase of 1% of a step (compared with 11% in females). Second, when the marriage was described as having a practical advantage for the families involved, both male and female respondents judged the hypothetical woman as more likely to marry her impal, but the effect was almost twice as strong in females (17–20% of a step) than in males (10–11% of a step). As above, the additional effects in the Main + Respondent (house) model were neglible and not significant.

Disgust

Using AIC_M as the criteria, two of the eight candidate models in Table S3 (see ESM) were well supported: Main (village) + Design, and Main (house) + Design. All others were substantially less well supported. In both models, summarized in Table 3, the

Table 3 Coefficients from the best-supported Poisson regression models used to estimate the effects of various factors on judgments of disgust toward impal marriage

Main Effect	Female respondents [a,b]		Male respondents [a,b]	
	Main (village) + Design	Main (house) + Design	Main (village) + Design	Main (house) + Design
Age	0.002	0.001	−0.019*	−0.019*
Time	0.495	0.465	−0.002	0.045
CS (3rd party)	−0.470**	−0.470**	−0.267*	−0.267*
CS (same village)	−0.032	–	−0.023	–
CS (same house)	–	0.013	–	−0.106

All models with female respondents are $n = 436$ (109 respondents); all models with male respondents are $n = 424$ (106 respondents)

[a] Significance: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

[b] Models control for design characteristics (i.e., set effects and order)

dependent variable was the amount of disgust felt at the prospect of the woman in the vignette marrying her impal on a three-point scale ranging from 0, not disgusting, to +2, very disgusting. There were substantive differences in the effects estimated with male and female respondents. Full details of the model are presented in Table S5 (see ESM).

In the model estimated with judgments from female respondents, as shown in Table 3, cosocialization of the woman in the vignette with her impal was the only statistically significant effect. Cosocialization led to 47% of a step *lower* on the disgust scale. The effect of framing the scenario in the past led to almost a half-a-step increase in judgments, but the effect was not statistically significant. The effects of respondent age and cosocialization with their own impal were negligible. In the model estimated with judgments from male respondents, the effect of the respondent's cosocialization with his own impal was negligible, as was the effect of framing the scenario in the past. The effect of respondent age and cosocialization of the woman in the vignette with her
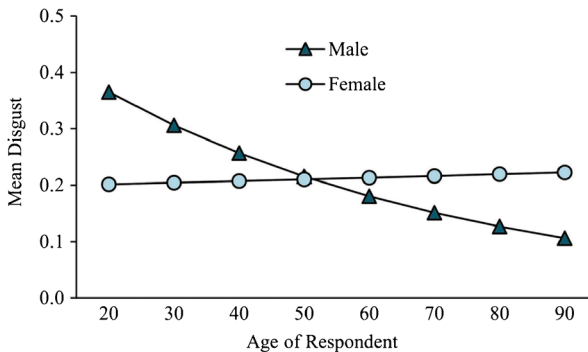

Fig. 4 The extent to which the impal marriage in the vignette was judged to be disgusting (on a scale of 0 to 2, where 0 was not disgusting, 1 was disgusting, and 2 was very disgusting) as a function of respondent gender and age, based on estimates from the best-fitting Poisson models

impal had substantive and statistically significant effects: cosocialization led to a 27% of a step *decrease* in disgust.

Figure 4 illustrates the estimated effects of respondent age by respondent gender. Among female respondents, reported disgust increases as a function of respondent age, but the effect is small. Changes in age of 10 years are accompanied by changes in disgust of approximately half a percent of a step in disgust rating. For male respondents, however, the effect of age was both large and in the opposite direction as that of female respondents, with younger men significantly more disgusted than older men at the prospect of the woman in the vignette marrying her impal.

Discussion

We used a vignette experiment to study the perceptions of Karo people regarding matrilateral cross-cousin (impal) marriage, a preferred arrangement that has been in decline for at least 75 years. Our first goal was to quantify the contribution of four potential explanations for the current low rate and decline of impal marriage—demography, religion, alliance, and negative imprinting—in judgments from Karo people about the probability a hypothetical Karo woman would marry her impal. Our second goal was to further test the negative imprinting explanation by assessing whether cosocialization of respondents with their own impal shaped their disgust response to the scenarios.

Many of the results were fairly consistent across male and female respondents. For instance, most factors had small and non-statistically-significant effects. Cosocialization of the hypothetical woman and her impal, on the other hand, had a substantive and statistically significant effect on both the probability they would marry and the amount of disgust felt by respondents when told that they did marry. The effect, however, ran counter to the prediction of the negative imprinting explanation—in other words, the hypothetical woman's having grown up in close association to her impal led to a higher envisioned probability of marriage and a lower level of third-party disgust.

One set of effects, however, did show an important interaction between gender and age of respondent. When asked how disgusting it would be if the hypothetical woman married her impal, there was a large effect of respondent age in male but not female respondents. Among women, there was only a slight increase in disgust with advancing respondent age; among men, however, there was an enormous effect for age. The younger the man, the more disgust he felt toward the prospect of the woman marrying her impal. Hence, despite the insignificant effect of framing the vignette in the past or present, these results may provide an important clue about the reasons for the decline of impal marriage.

These patterns are particularly striking given that women typically report stronger disgust reactions than men both toward other disgust elicitors (e.g., Curtis et al. 2004; Tybur et al. 2009) and as third-party reactions to sex between close kin (Antfolk et al. 2012a, b; Fessler and Navarrete 2004). Accordingly, although framing the vignette as occurring in the past or in the present did not affect responses, the substantial increase in negative responses to impal marriage among younger men may provide an important clue regarding the reasons for the decline of impal marriage, as this pattern is not explicable merely in terms of the overarching effects of gender on disgust reactions.

In the judgments of Karo people, impal marriage is much more likely, and much less disgust-inducing, when the vignette's actors have lived in close association from a young age. This is quite a departure from Kipp's (1986) account of a common objection to impal marriage by Karo people themselves: that impal couples are so close, they often see themselves more as siblings than as potential lovers. The latter description was instrumental in Fessler's (2007) identification of impal marriage as a possible case of Westermarckian negative imprinting. Do the results of our experiments definitively rule out negative imprinting as a viable explanation for the decline of this type of marriage?

First, in attempting to answer this question, it is important to note that Westermarck's (1891) ideas have been expanded, with evidence suggesting it is more than just cosocialization that leads to negative imprinting (Lieberman 2009; Lieberman and Lobel 2012; Lieberman et al. 2007; see also Wolf and Huang 1980). For the younger of a pair, cosocialization is key, and there appears to be a critical period within which the effect is stronger the longer the period of cosocialization. For the older of the pair, it is observation of one's mother providing care to the younger. Within the context of the vignette, we explicitly examined only cosocialization; although we enlisted both male and female respondents, the central character in all vignettes was a woman, and, as in most societies, it is normative among the Karo for the woman to be younger than her spouse. Our examination of the respondent's own childhood history vis-à-vis his or her impal does allow us to encompass both cosocialization and maternal perinatal association since respondents will differ with regard to whether they are older or younger than the impal with respect to whom they answered our cosocialization query. However, in contrast to the substantial positive effects on respondents' judgments of our descriptions of cosocialization within the vignettes, respondents' own childhood histories had no effect on their assessments. Nonetheless, it is important to keep in mind that our measures of childhood experience were both less direct and of considerably lower resolution than those employed in some previous research, and thus we cannot rule out the possibility that our null results in this regard reflect the limitations of the methods employed.

Next, we must keep in mind the strengths and limitations of the methodology we have brought to bear on the problem (Atzmüller and Steiner 2010; Kushnick 2013). On one side, factorial vignette experiments allow for the study of decisions, behaviors, and cognitive processes with complex causation, and, despite the reasonable objection that they sacrifice ecological validity, judgments from vignette experiments often closely match their real-world equivalents. On the other side, judgments may reflect reality poorly when respondents have little experience with the phenomenon in question, or responses in the real world are modulated by mechanisms that are not triggered in a contrived experiment.

Using this logic, perhaps judgments that cosocialized impal are more likely to marry might be based on naive assumptions about the importance of knowledge of one's partner in social relationships. Norton et al. (2007) report on a series of experiments showing that people believe increased knowledge of another person should lead to liking them more, despite the fact that, in actuality, they like them less when they do get to know them (see also Norton et al. 2011; cf. Reis et al. 2011a,b). Judgments that impal marriages between non-cosocialized pairs were more disgusting than those beween cosocialized pairs may have resulted from a lack of familiarity with the feelings

of those who have actually been paired with their impal. Respondents were sampled from the Karo population at large. Because of the low rate of impal marriage, most respondents have had limited interaction with married impal couples. This dissimilarity may foster mistaken beliefs about the actual feelings of cosocialized impal whose families would like them to marry. Despite this, in contrast to previous research on third-party judgments of this type (Fessler and Navarrete 2004; Lieberman et al. 2007), we found no statistically compelling evidence that respondents, male or female, who were cosocialized with their own impal (whether defined as number of years from birth to age ten in the same village or in the same house) find impal marriage more (or less) disgusting than those who were not thus cosocialized.

The latter pattern suggests one of two possibilities. On one hand, it is possible that, in both the past and present, conventional impal cosocialization practices have not involved sufficient intimacy, extent, and duration as to trigger the kin-recognition mechanisms that lie at the heart of Westermarckian negative imprinting. In this account, neither direct experience of cosocialization with one's impal nor third-party knowledge of the sentiments that obtain between cosocialized impal pairs would lead respondents to view marriages between such pairs in a negative light, while previous reports that impal marriage was subjectively experienced as incestuous (Kipp 1986; Singarimbun 1975) may be owing to metaphorical use and an overly literal reading of emic descriptions of the process of navigating the kin-based social structure. On the other hand, recognizing that said previous reports are based on ethnographic research that took place many decades ago, it is possible that, in the past, conventional impal cosocialization did indeed involve sufficient intimacy, extent, and duration as to trigger Westermarckian responses, yet such practices changed over time, with the result that respondents under the age of 50 or so may have no familiarity with sexual aversion obtaining between cosocialized impal.

A definitive ruling out of the negative imprinting hypothesis will require triangulation with careful analysis of marriage outcomes. Wolf's study of sim pua "minor" marriages in Taiwan serves as an excellent model, wherein analyses of the success (i.e., rates of childbearing, divorce, and infidelity) of sim pua versus "major" marriages is a keystone piece of evidence supporting the contention that the co-reared future spouses experience a Westermarck effect (Lieberman 2009; Wolf 1966, 1995). In our ongoing study of impal marriage using ethnographic materials, we are conducting similar analyses of marriage success with comparisons of impal versus non-impal marriages, and impal marriages with cosocialization versus those without.

Gender and Social Change

As noted above, perceptions of impal marriage among the Karo may have changed over time; this could be due to changes in socialization experiences, changes in attitudes toward traditional kinship-based arranged marriages, or both. We attempted to measure such changes in two ways. The first, aimed particularly at changes in overt attitudes (which, unlike the consequences of cosocialization, would likely be explicitly recognized as such by participants), involved framing half of the vignettes in the present and half in the past by including a dummy variable (Time) while controlling for age in the regression models where framing in the present was the index value. The second, intended to probe differences in both overt norm-based attitudes and more

implicit experience-based attitudes, involved stratifying our sampling of respondents by age to test for a secular trend in feelings toward the practice. The first method yielded very little. In the likelihood of marriage analysis, there was no effect of time when controlling for age for both male and female respondents. In the disgust analysis, there was no effect of time when controlling for age for male respondents and a substantive but not significant effect for females. The second method revealed an interaction effect, as illustrated in Fig. 4. There was a slight decrease in disgust in younger women, and a dramatic increase in disgust in younger men. Our analyses would have benefitted from knowing how respondents interpreted the retrospective hypotheticals but, alas, we did not collect that information.

It is possible that the age effects we found reflect alterations in individuals' experiences or perspectives as a function of their respective positions in the social structure. However, given the breadth and rapidity of cultural changes throughout Indonesia in recent decades, we think it more likely that the differences among our respondents by age reveal cohort effects wherein younger people hold different views than those of their elders because prevailing attitudes are changing. Markedly, the gender differences among our younger respondents suggest that men's and women's views regarding impal marriage have changed in opposite directions. This suggests that an evolutionary account of the change in this type of marriage might need to account for the role of sexual conflict (Borgerhoff Mulder and Rauch 2009; Gorelik and Shackelford 2011; Parker 1979), parent-offspring conflict (Apostolou 2007; Kushnick 2006; Trivers 1974), and sibling conflict (Borgerhoff Mulder 2007; Mace 2013; Mock and Parker 1997). The reasonableness of this proposal is supported by the nature of the arrangement of impal marriages (Singarimbun 1975). While siblings do try to arrange impal marriages between their offspring, often at the behest of their own parents, the couples themselves have a say. How much say they have is an open question because little is known about how effective brideprice payments are as a manipulative tool in Karo society.

One result speaks to these conflicts. The effects of alliance were quite different when estimated using judgments about the probability of marriage from male and female respondents. Put another way, when there were alliance ramifications (i.e., landholdings that would be "beneficial to keep in the family") for the marriage of the hypothetical Karo woman and her impal, female respondents judged them as approximately twice a step more likely to marry than did males. The factors responsible for this gender difference is not entirely clear since intergenerational flow of resources in matrilateral cross-cousin marriage is diagonal with respect to gender (Flinn 1981). Our ongoing analyses of the ethnographic data will allow us to move beyond the *ceteris paribus* nature of the experimental data as they will facilitate the exploration of interhousehold differences in wealth and other relevant factors affecting the magnitude of the conflicts.

Our results suggest that men may have played a principal role in driving down the rate of impal marriage in recent years. Nevertheless, despite the patriarchal nature of Karo patrilineal social structure (Kushnick 2010), if the alliance ramifications of impal marriage are more beneficial for women than men, we might expect a higher rate when postmarital residence is matrilocal, as women might hold more sway when they are surrounded by kin (Leonetti et al. 2007; Mace 2013). Since this normally occurs when husband and wife share the same natal village, this may well provide a partial

explanation for our finding that marriage between impal is viewed as more likely when the couple have grown up in close association.

Summary

We used a vignette experiment to quantify the changing perceptions of Karo people about how multiple factors influence the likelihood an impal couple will marry, and their feelings of disgust in response to the idea that the couple actually do marry. Our aim was to explore a broad range of explanations for the low frequency and decline of impal marriage. Keeping in mind that the nature and resolution of our methods is such that our findings should be considered preliminary, our results can be summarized as follows: First, for both male and female participants, cosocialization of a hypothetical woman and her impal had a strongly positive effect on participants' assessments of the likelihood that they will marry, and a negative effect on participants' feelings of disgust when they did. Second, the alliance-building ramifications of the marriage had a much stronger effect on female than male respondents with regard to the perceived likelihood of marriage, suggesting that the costs and benefits of impal marriage differ for men and woman. Finally, marriage between a woman and her impal had markedly different effects on feelings of disgust by participant age and gender. Among male respondents, younger men were much more disgusted by an impal marriage scenario than were older men. Among female respondents, the opposite was true, but the effect was nowhere near as large. This suggests that men may have played a more appreciable role in driving this case of social change. Having identified candidate factors using experimental vignette methodologies, we now look forward to using complementary methods to further illuminate the complexities and gender dynamics operating in this case of social change.

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